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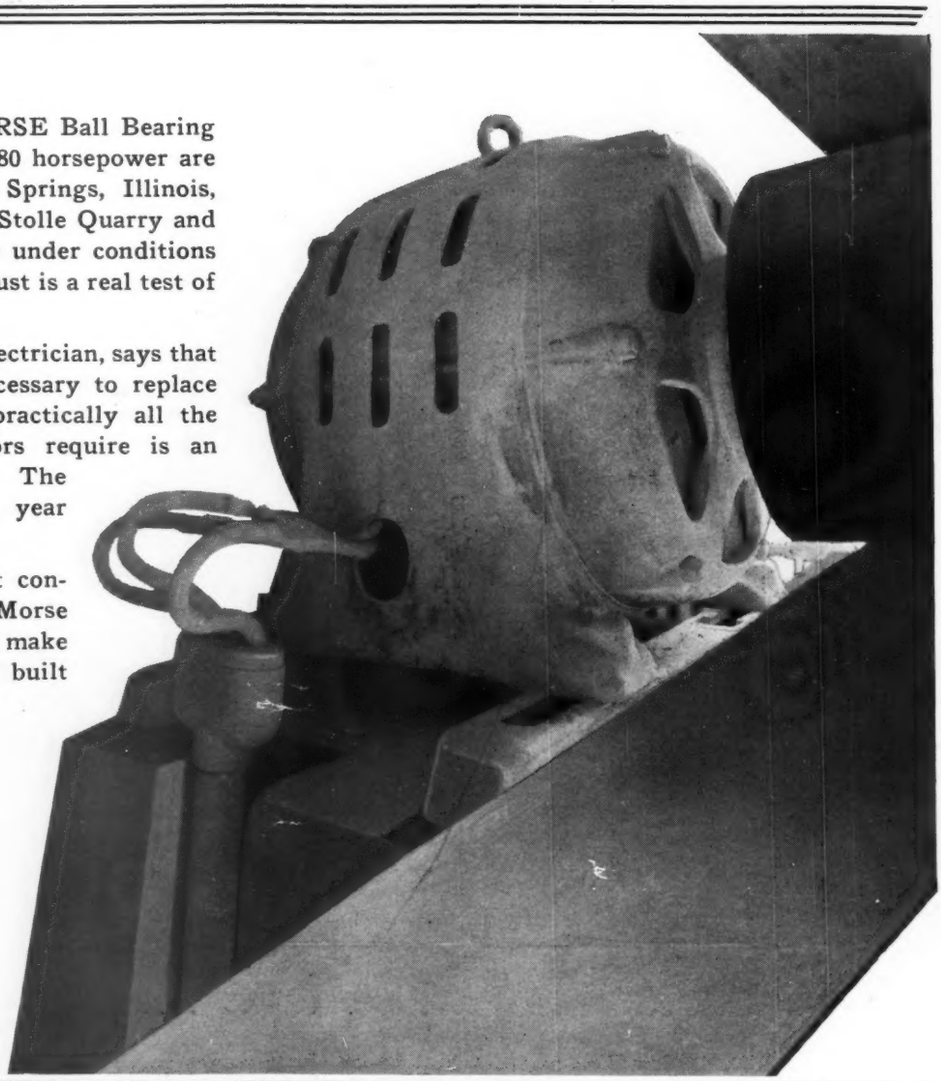

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Contents for November 23, 1929

VOLUME 128, NUMBER 21

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Editorials 799

ANALYSES OF FAILURES Provide Suggestive Lessons . . . To Resist Group Opinion Requires Courage . . . Cleanliness, Order, and Production Efficiency . . . Mining Industry Should Advertise Its Achievements . . . The Spectacular Need Not Be the Significant . . . Vanadium: An Important Junior Metal . . . Mining Education Involves Experience by Travel.

Electrical and Mechanical Maintenance 802
GEORGE J. YOUNG

Dust 807

Spotting Mineral Deposits by Airplane 812
A. J. MOORE

Open-Pit Salt Mining in Utah 814

The World's Gold Production 818

Economy and Efficiency of Electric Furnace Is Demonstrated in Mine Foundries 820
W. E. LEWIS

Comment and Criticism . . 815
Book Reviews 818
Industrial Progress 820
Personal Notes 823
Obituaries 823
Mining News 824
Market and Financial News 832
Market Report 834
Mining Stocks 836
Service Directory 29
Searchlight Section 30
What and Where to Buy 34
Advertising Index 38

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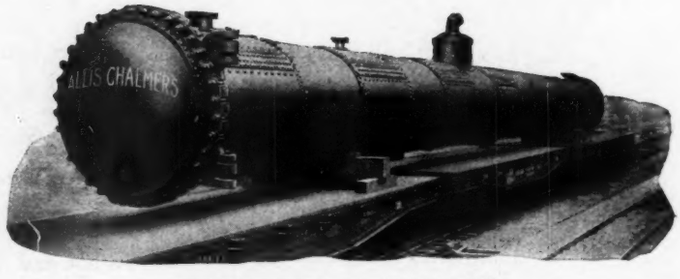

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ENGINEERING AND
MINING JOURNAL

A McGRAW-HILL PUBLICATION — A. W. ALLEN, *Editor* — ESTABLISHED 1866

VOLUME 128 — New York, November 23, 1929 — NUMBER 21

Analyses of Failures Provide Suggestive Lessons

MUCH has been written about the policies and methods adopted by progressive and prosperous companies; little about the fundamental causes of failure on properties characterized by diminishing earnings and high labor turnover—which usually go together.

Illogical conservatism is a characteristic of many executives, especially those in charge of operations in isolated districts. An abundance of labor may be available. A small amount of machinery, although obsolete from every standpoint, has been doing the work fairly well for many years. Sentiment resents a change. Moreover, the scrapping of old plant and the substitution of modern equipment involves at times a heavy expenditure, and this, in turn, demands courage. And when courage is absent one need go no further for a reason for shrinking income and staff dissatisfaction.

To be successful, one must keep abreast of the times. The executive should realize that the modernization of a plant invariably increases output, fosters a greater degree of contentment among the employees, reduces production costs, and provides a surplus that is available for amortizing the cost of the new equipment. A thousand and one examples might be cited to prove the truth of this statement.

Again, the practice of frugality in an endeavor to keep within an unreasonably small monthly expenditure budget seriously hampers operations and increases costs, especially when a delay in making necessary repairs to equipment and buildings results in complete breakdown, with its attendant evils of output stoppage, rush work, overtime wages, and heavy expense, usually unprovided for in the budget. The question may be asked then as to why a program for improvement proposed by a zealous subordinate so often meets with a cold reception. Often the attitude results from the fact that a new process or a more modern machine had previously been recommended for adoption or purchase by one who was insufficiently experienced in analysis and judgment. The result, instead of benefiting the company, caused a loss of money, if not other disadvantages. The responsible executive probably received a rebuke from headquarters, thenceforth turning a deaf ear to all proposals involving the adoption of new equipment or of innovations in practice.

Jealousy and lack of harmony among the members of the staff of a mining company are sometimes also contributory causes to unfavorable economic results. Differences between the mine superintendent and the mill superintendent, between the master mechanic and the chief electrician, and among many other operating officials, are more than sufficient to account for many a slump in earnings—a slump not otherwise explainable.

Agreement and contentment are two factors essential to smooth operation. The executive in charge should do everything possible to encourage a willing spirit of cooperation between the various units of his staff by holding frequent meetings at which ideas may be exchanged and improvements discussed and planned whereby production may be increased and costs reduced—to the benefit of all concerned. A frequent social gathering or a staff dinner has been proved a helpful means of diminishing friction and insuring a better understanding.

The task of adjustment, however, cannot be shouldered entirely by those in executive positions. Every employee will find that he himself will be the loser if he systematically evades responsibility and blames his superior for poor results. To be technically efficient is not enough. One must also be human and considerate in one's relations with fellow-workers.

To Resist Group Opinion Requires Courage

THE president of Yale University recently deplored the "withering and blighting uniformity" that characterizes American college life. "To be different," he says, "is to risk seeming eccentric, vain, opinionated." And to gain a reputation for such divergence from accepted standards is to jeopardize the opportunity for social recognition that is dear to the heart of the undergraduate. This tendency to be uniform finds expression in underlying trends of thought, as well as in superficialities of dress, speech, carriage.

Such an attitude, if persisted in, is even more withering and blighting in its effect on thought in after life. Book learning may be finished at graduation, but education is only begun. A well-drilled sense of acquisitiveness must be replaced by a natural inquisitiveness—the spirit of true research—that insists on a foundation of first-hand knowledge to support the beacon of recently acquired fact.

Better a disappointment in a new adventure, with its valuable lessons, than to trade on the initiative and experience of others, most of whom experienced failure before they achieved success. The noteworthy advances of the last quarter of a century have been due to those who had the courage to resist group opinion, who refused to see finality in achievement to date. Many engineers, however, find that agreement with majority viewpoint, so-called, is the easier course. It involves no thinking. Responsibility is evaded. The risk of failure is small. But the door is shut on great opportunity.

Cleanliness, Order, and Production Efficiency

VARIED EXPERIENCES in many countries lead to the conclusion that a disorderly plant is the outcome of slovenly thinking and poor planning. Those in charge of such a plant are not always responsible. In most instances they are the victims of circumstances beyond their control, and the only course for them is to accept the inevitable, with its load of worry and disappointment.

No one in a responsible position, or in a subordinate one, either, can be expected to maintain an enthusiasm for work that must be performed under conditions for which no obvious remedy is apparent. He may be excused for dilatory performance, for keeping an eye on the clock, for concentrating most of his thoughts on the possibility of securing another job elsewhere. The American standard of living may be high, but the standards of order, cleanliness, and ventilation obtaining in many an American plant are as deplorably low as in countries where prosperity is less in evidence, where excuses for avoiding plant reconstruction are to some extent justified.

Inefficiency, poor technical result, high cost of operation, labor turnover, friction and discontent may often be traced to faulty design and arrangement of plant units, to an unnecessarily close grouping of apparatus, to a failure to anticipate normal expansion and the normal sequence of cause and effect.

Mining Industry Should Advertise Its Achievements

THE coinage of a term to express an idea implies inventiveness. If the term meets with acceptance, general usage spreads and its origin becomes obscure. Mr. Charles W. Merrill, of San Francisco, used the term "mineral-minded" at a meeting in Los Angeles not long ago. It proved convenient and expressive, and since then has found wide acceptance. One now hears about a mineral-minded people, as applied to one mentally active section of the population.

Mining men are mineral-minded. Perhaps they are born that way. The general run of the population is not mineral-minded, chiefly because every-day life offers few reminders of the mineral deposit, the mine, mineral production, and the activities of the miner and his co-worker, the metallurgist. Mining is away from the cities, except so far as foundations for skyscrapers and tunnels for subways and water supply are concerned. It does not intrude itself in the life of the individual, useful as the products of the mines and quarries may be to him.

In a quantitative sense the mining industry is in a small minority. An essential activity, it is nevertheless overshadowed by the drama of civilization. When necessary for the industry to appear in the public forum—to secure concessions or to protect itself from tax exploitation—its voting strength is scattered, and, in the aggregate, relatively small, far smaller than its economic importance justifies. It is thus at a disadvantage.

The mining industry must gain adherents and sponsors. In furtherance of this need, an educational campaign has been started in several places. To make the virile part of a population mineral-minded is an important and practicable objective. If the idea is broadcast often enough, the mineral industry will get the support it deserves. But effort, which must be persistent, should be furthered by mining organizations and the press.

As an example of the value of the peaceful penetration of propaganda designed to stimulate public appreciation of professional and industrial effort, note how the American Chemical Society and numerous talented authors have succeeded in recent years in deflecting attention to the part played by the chemist in scientific and commercial progress. With a much more dramatic and more vital tale to tell, the miner and the metallurgist, if organized as well as their chemical confrères have been, should find no difficulty in recapturing credit for a fair share of the initiative and courage and keenness and talent that have played so conspicuous a part in the attainment of present-day civilization.

The Spectacular Need Not Be the Significant

WHOSE imagination can fail to be stirred by the remarkable and almost miraculous discovery of the MacAlpine party after two months of heart-breaking, unavailing search? The actual record of the disappearance of the eight flyers into the barren stretches of the frozen North, of the efforts of scores of their associates to find them, and of the successful culmination of that effort when the radio reported them safe on Cambridge Bay, Victoria Land, seventy degrees north of the equator, might well have formed the basis of one of Jules Verne's most fantastic tales. The airplane—the instrument that was the cause of their disappearance—was also the instrument that made possible their rescue.

To use this heroic episode as the basis for a eulogy of the airplane would be easy. But to *Engineering and Mining Journal,* stirring as it may be, the rescue of the MacAlpine party does not seem as significant as the report of Western Canada Airways for the month of August. Unlike Dominion Explorers and the N.A.M.E. and kindred organizations, Western Canada Airways is not an exploration company. Its purpose is solely transportation, and it serves, for the most part, the mining centers of the Canadian West. During August this organization operated a total of twenty-seven airplanes; carried 1,774 passengers and 335,466 pounds of express, baggage, and mail; and covered 109,484 miles in 1,338 flying hours. Mining accounted for the greater part of the total business done. In the use of the airplane as a means of reaching outlying mining districts, the Canadian mining man has far outstripped his colleague to the south. The difference, of course, is accounted for largely by the lack of any other rapid methods of transportation in the sparsely settled parts of Canada. But the safety and the efficiency of the airplane have been demonstrated. The mining engineer who has visited the Howey, the Sherritt-Gordon, or any other of the outlying mines by plane will be more inclined to use it when he has to get from Salt Lake to Phœnix in a hurry.

Vanadium: An Important Junior Metal

ONE hundred and fifty years ago vanadium was an undiscovered element; a century ago it was a chemical curiosity. Beginning about seventy years ago, some attempt was made to investigate its beneficent effect on iron, to isolate it as a metal, and to employ its compounds usefully. But only in the last quarter century has vanadium become a commercially important element. Its value became generally realized as an alloying element for steel, the product early being widely used for armament and for automobile construction. Discoveries of adequate and comparatively cheap sources of supply in Peru in 1905 made possible the development of the vanadium industry on a scale larger than had heretofore been possible.

Research has found many new uses for the element and its compounds since the World War, so that its production seems destined to expand consistently. In general, its applications may be divided into two fields, metallurgical and chemical. In the former, carbon-vanadium drill steel, shafts, and castings are used in mining; chrome-vanadium connecting rods, springs, gears, and steering mechanisms in automobiles, with carbon-vanadium crankshafts; chrome-vanadium gears, shafts, and spindles in industrial machinery, together with low-alloy and high-speed tool steels; chrome-vanadium tubing, valve parts, and boiler plate for steam generation, with vanadium steel for high-pressure steam drums; chrome-vanadium still tubing, valve parts, and reaction chambers in oil refining; carbon-vanadium drill bits, jars, and sucker rods, with chrome-vanadium tool joints, in oil-well drilling; chrome-vanadium propellers, shafts, gears, connecting rods, and landing-gear parts in airplanes; chrome-vanadium tubing, catalyst chambers, and bolts and nuts in nitrogen fixation. In the railroad industry the applications of vanadium are numerous, including carbon-vanadium steel for frames, pins, piston rods, axles, crossheads, and side rods; chrome-vanadium for piston rods and springs; nickel-vanadium steel for frames; and silicon-vanadium for springs.

The applications already found for vanadium and its compounds in the chemical industries include its use as a drier for linoleum and varnish; an accelerator for rubber; a catalyst for sulphuric acid; a coloring and ultra-violet absorbent in glass and ceramic manufacture; a reagent in the manufacture of phthalic anhydride in organic synthesis; for developing and coloring films in photography; in printing and lithographing inks; as a catalytic agent in oxidation for soil improvement, and as an oxidizer of sulphur in insecticides manufacture; in cancer and syphilis treatment, and in the making of antiseptics and disinfectants; and in the dying industry in connection with aniline-base colors and analine black.

This information is culled from the first of a series of quarterly publications by the Research Department of the Vanadium Corporation of America, to be known as the *Vancoram Review*. Current publications relating to vanadium in the technical press are abstracted in each issue, so that the present and prospective user of this relatively new element can easily keep abreast of technical progress. The idea would seem to be an excellent one for adoption for any company interested in widening the use of a comparatively unknown product.

The Vanadium Corporation gets its principal supply of ore from the famous deposit, Minas Ragra, Peru, in which the element occurs in patronite, an amorphous black mineral of the probable composition VS_4, though a part of the deposit is oxidized. Last year only a small amount of this ore was imported into the United States, accumulating stocks doubtless being drawn on, but so far in 1929 an average of about 500 tons a month has come into the country.

United States production figures are not available, but it is known that a subsidiary of the Union Carbide & Carbon Corporation is active near Rifle, Colo., where vanadium-bearing sandstone is found, the minerals of value being roscoelite (a vanadium mica) and vanoxite (hydrous vanadium oxide). Another company also owns deposits in Colorado, and in Utah as well. South Africa and Northern Rhodesia are important producers for the European market, the element there being chiefly in the form of vanadates.

Though vanadium minerals must remain comparatively rare, the element seems sufficiently well distributed in the world to assure a supply, even though the consumption increases materially, and also to encourage considerable competition in the vanadium industry.

Mining Education Involves Experience by Travel

A ROLLING STONE GATHERS no moss, but it acquires a polish. Similarly, the itinerant mining engineer does not always amass riches, but he certainly gains valuable experience by going abroad. The distribution of mineral wealth over the surface of the globe is so scattered that a knowledge of the deposition of ores and the various methods of extracting and treating them cannot be acquired by those who stay in their old home town. The education of a mining engineer really begins after he leaves college, when he begins to travel.

Among the more distinguished members of the mining profession is Dr. J. Malcolm Maclaren, whose wanderings, according to a correspondent of the *Daily Mail*, entitle him to be credited as "the second most traveled man in the world." Curiously enough, another mining engineer, Mr. J. H. Curle, now better known for his fascinating books on the peoples of the world and the trends of the times than for his earlier professional writings, is given first place as a nomad, with a travel record exceeding one million miles.

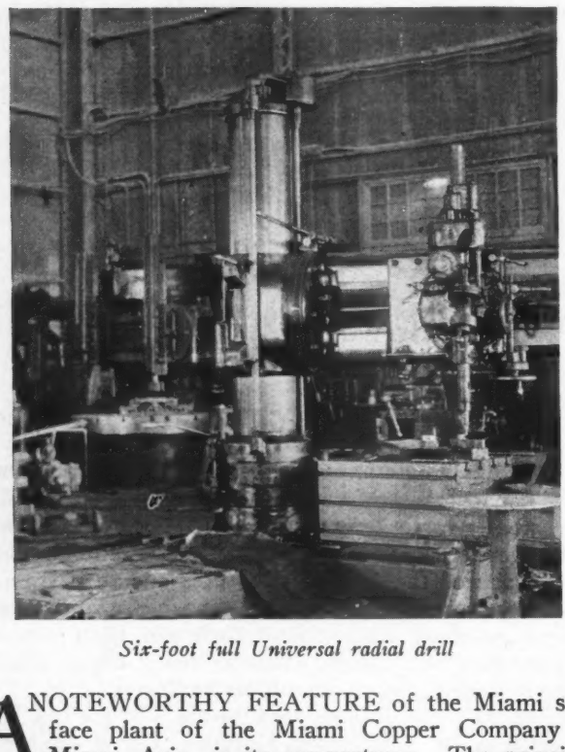
Doctor Maclaren, according to his interviewer, seems to have avoided much duplication in travel, for his record indicates that he has covered all the countries in Europe except Denmark, all in Asia except French Indo-China, all of the Americas except Ecuador, all of Australasia, and all of Africa except the West Coast. Between January and August of the present year he visited Australia, Africa, Chile, Peru, Argentina, and Bolivia. Of the fourteen months prior to August he spent seven at sea.

The time may be drawing nigh when "ocean" travel will be a thing of the past. When that day arrives the itinerant mining engineer will be deprived of one of the advantages of his professional duties—opportunity to think and plan, and to write, during a sea voyage, which, even on a fast boat, is a restful experience.

Electrical and Mechanical Maintenance

Apparatus and Technique Employed by the Staffs of the Miami Copper Company at Miami, Ariz.

G. J. YOUNG



Six-foot full Universal radial drill

A NOTEWORTHY FEATURE of the Miami surface plant of the Miami Copper Company at Miami, Ariz., is its compactness. The principal working shaft delivers its product into a circular concrete bin in the ore-crushing building. Belt conveyors deliver the crushed product to the mill bins a short distance away. The shops for repair and maintenance are an extension of the mill building, the bay containing the grinding units connecting with the machine shop. The plate shop connects with the machine shop, with an outer yard, and sheds near by. Close to the hoist building are the drill-sharpening and car-repair shops. At a lower level and connected by an adit with the shaft are the timber yard, timber-preparation, and timber-treatment units. The power house is also at this lower plane.

A system of mine tracks, standard-gage tracks, and roadways connects all points on both upper and lower planes. The ore handled is about 13,000 tons per day, the end product being a rich copper concentrate. Plans are under way to mine and treat 18,000 tons per day. Ore treatment involves crushing, fine grinding, flotation, and concentrate re-treatment. The important units are Symons cone crushers, a Newhouse crusher, power screens, rolls, Hardinge and Williamson mills, Dorr classifiers, and flotation machines.

The three groups of shops, one at the mill, one at the mine shaft, and one at the power house at the base of the ridge, serve separate functions and are so placed as to involve a minimum of transportation to and from their important service points. The organization for repairs, maintenance, and new construction is under H. Bible, mechanical superintendent. Two divisions are tributary: machine, plate, blacksmith, and tin shops under F. J. Martin, general shop foreman, and the electric shop under J. J. Luchessa, chief electrician. O. B. Lindquist is in charge of the mine shop, which is under the mining department, as is the timber preparation and treatment division. E. B. Lane is in charge of the power plant. Designs and preliminary work are handled in the mechanical superintendent's office by assistant engineers. Each of the subordinate offices has its files, accountant, and assistants. The organization involves distinct divisions of responsibility, but these can be readily co-ordinated when necessary.

The machine shop is on an extension of the grinding bay of the flotation mill. One end of the shop is served by the traveling crane over the grinding units, so that individual units can be lifted out and transferred to the shop. The shop is thus an extension of the mill. Service to the crushing plant is afforded by the track system and an incline served by a hoist. Likewise, a track and incline connect with the yards at the base of the ridge upon which the mill and shaft outlets are placed. The handling of heavy units from railroad cars to plant and from parts of the plant to shops requires special planning and has been worked out in this instance for an unusual environment.

Lathe equipment consists of a Lodge & Shipley long-bed lathe, 24 in. x 20 ft.; a Le Blond lathe, 20 in. x 16 ft.; an American lathe, 20 in. x 10 ft.; and a large engine lathe, 48-in. swing by 20-ft. centers, the swing increased to 63 in. by blocks under tail and head stocks, for work on roll shafts with cores attached. A McCabe lathe, 36x54 in., 10-ft. centers, is also a part of the lathe installation. Other equipment consists of a 6-ft. full Universal radial drill; a 40-in. drill press; a 36x40-in. planer; a 72-in. boring mill (48 in. under rail); a

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This is the second of a series of articles on the efficient and economical control of equipment used in mining and metallurgical operations. The first article of this series, on practice and results at the United Verde Copper Company's plant at Clarkdale, Ariz., was published in the issue of Nov. 2.

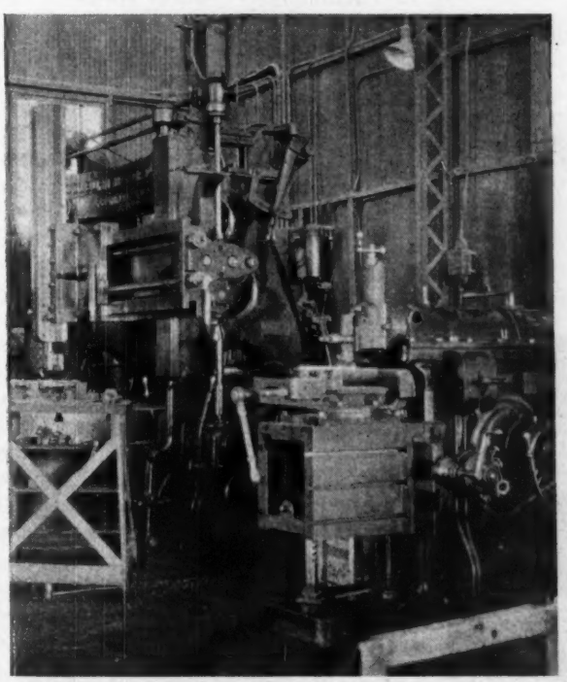
Le Blond No. 3 milling machine, a slotter, taking up to a 2½-in. keyway; a Peerless power hacksaw; a double full ball-bearing emery wheel; and a 250-ton portable hydraulic press. For pipe and bolt work, two Nationals are available, one for pipe up to 10 in. in diameter and the other for bolts up to 2½ in. in diameter. A 14-in. Le Blond lathe, 10-ft. centers, is used in the tool room as well as a small Cincinnati grinder. A 16-in. x 10-ft. centers American lathe with special tool-room equipment is also installed. A 36-in. x 20-ft. lathe and a 42x54-in. open-side planer are planned. The tool-room facilities are as good as any to be found in shops of like character and the shop facilities were planned to handle any job about the plant.

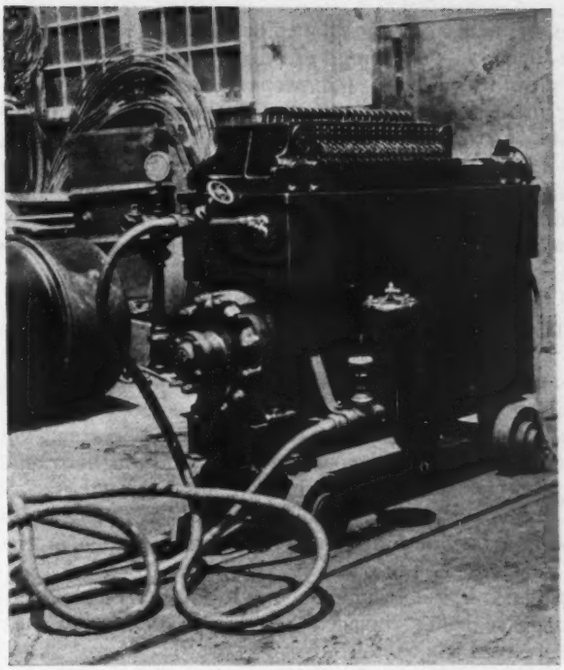
Forge or blacksmith-shop equipment consists of two forge fires, an oil-fired heating furnace for 12-in. billets, and a Niles-Bement-Pond 2,600-lb. air hammer. The plate shop contains bending rolls to take a ¾-in. x 10-ft. plate, and clamps for flanging, a No. 2 Hills & Jones combination shear and punch for ¾-in. plate and 32-in. throat, and a Ryerson slitting and angle shear for ¾-in. plate. Welding equipment consists of a stationary Westinghouse welder, three 500-amp., 60-volt, operator units, and two Lincoln portable 325-amp. single operator units. In addition, enough equipment has been provided to supply eight acetylene welders. An Oxweld acetylene generator supplies acetylene gas.

A great deal of plate work was in progress for the new construction at the mill. Launders, chutes, feeder spirals, pump boxes, and classifier boxes, as well as flotation cells for the changes and additions, were being constructed. Welding is almost universally used for this class of work. A rubber lining is used where abrasion is encountered. The new launder work involves the use of some 40,000 lb. of rubber.

Fabrication of structural steel for the extension to the mill building was carried out in the shops. Routine maintenance work in the mill is supervised by the mill superintendent and is carried out by a general repair foreman. The same plan is followed in the crushing plant. Roll shell replacement and work on screens, conveyors, and crushers are in charge of the operating crew, but where repairs are out of the ordinary, or require more skill than is forthcoming from the operating crew, shop mechanics are placed upon the job.

Seventy-two-inch boring mill and slotter





Filter press and pump used in cleaning transformer oil

An unusual but not surprising shop job was the construction of 60 gable-end, side-dumping cars constructed from designs and improvements made in the original 84-cu.ft. car used in the mine. These cars are equipped with Timken roller bearings and carbon steel axles. Another order for 90 cars has been placed in the shop. A special crew is engaged in their fabrication and erection. The 100-ft. flotation cells were also constructed in the plate shops, as well as the 15-ft. cleaner cells. Among the unusual jobs was the repair made to the frame of the Newhouse crusher. The repaired frame gave satisfactory service, although some doubt had been entertained as to the success of the job. Another job entailed the reinforcing of the drum on the ore hoist. A concentric fracture developed upon the drum. Holes were drilled in the drum flanges and fourteen rods inserted, tying the drum together. The rods were heated before being placed, and in this way tension was increased. Although considerable trouble was experienced with the crushing rolls, as a result of hot bearings, this has been overcome by the use of an oil circulation system with filter, storage tank, and gravity feed.

The normal shop force consists of 43 to 45 men in the machine shop; five to nine welders; five in the blacksmith and forge shop; and 28 to 32 in the plate shop—a total of 81 to 91. About 75 men are on new construction.

Mine Shops

The mine shops handle all underground repair and maintenance work except the electric locomotives. Three small shops are especially equipped for this work, the drill-sharpening shop, the car shop, and a machine shop, all in charge of O. B. Lindquist.

The drill-sharpening shop is operated on a single-shift basis. It is equipped with three I.R. sharpeners, three punches, three oil furnaces, one tempering furnace, two blacksmith fires, and a 100-lb. air hammer. About 1,100

pieces of steel are handled per day by three sharpeners, three helpers, one temperer, and one helper. These men clean, straighten, and prepare the steel for sharpening in the afternoon. Owing to the existence of soft ground, considerable plugged steel must be handled. Steel comes from the mine at about 1:30 p.m. By the end of the shift all steel is ready for sharpening next morning.

One mechanic is engaged on drill repairs and handles about sixteen machines per day. The number of machine drills in operation is twelve drifters, 157 stopers, 223 hand-held drills, and 30 hitch cutters. The machine shop is equipped with a drill press, a radial drill, a power hacksaw, a pipe machine (1 to 6 in.), a pipe and bolt machine (1½-in. bolts, 1-in. pipe), two short-bed lathes, 18 in. and 24 in. swing; a shaper, an acetylene cutting outfit, a machine drill repair bench, a 100-ton hydraulic press for car and axle work, and an overhead trolley crane and chain blocks. Two lathe hands, two drill press hands, and one pipe and bolt hand are available in the shop.

Car work is the principal item in shop repairs. Car bearings are being replaced by Timken roller bearings at the rate of about four cars per week. Cages, skips, and timber trucks are kept in repair. Two mechanics are underground part of the time. The underground repair crew consists of a machinist, three laborers, and two helpers. Two pump men, one on each shift, service two quintuplex 150-g.p.m. Aldrich pumps, which operate ten hours per day on the 1,000 level, and a small 30-g.p.m. duplex pump. The underground repair crew services loading pockets, shaft piping, ventilating doors that are operated by 300-lb. water pressure, freight and passenger elevators, sinking hoist on the 1,000 level, car hoists, and 24 Tugger hoists that are in use on levels, raises, and at the cage shaft. A car barn repairman, foreman, and three helpers service mine cars. Both machine and sharpening shops are in charge of working foremen.

The Miami plant is completely electrified. The company operates its own power plant, and generates and distributes its electrical power. As a consequence, electrical machinery maintenance is an important factor contributing to operating efficiency. All electrical work is in charge of J. J. Luchessa. Surface current distribution is at 6,600 volts. It is distributed to eight transformer substations, the principal station being at the mill. At this substation a new switchboard in twenty self-contained units, assembled complete at the factory, has just been installed. The units were erected and bolted together, the job requiring five men and four helpers, for one day. This in itself is an instance of efficient manufacture. The principal bank of transformers is placed in this substation and is arranged for remote control. All transformers are inspected at regular intervals, and once a year the oil is tested for dielectric strength and removed and filtered when necessary. No alternating current is used underground. Direct-current lines, 250 volts, are carried into the mine through a steel-incased bore hole and are used for trolley lines, lighting, ventilating fans, and pumps.

The principal ventilating fan, exhausting 100,000 cu.ft. at No. 4 shaft, is operated by a 150-hp., 440-volt motor. At No. 3 shaft a smaller fan is operated by a 100-hp., 440-volt motor. Underground fans of the Sirocco type are used for local ventilation. Some six of these are operated by 15-hp., direct-current, 250-volt motors. An important job is the maintenance work on the electric locomotives, of which eighteen are Baldwin-Westinghouse and ten are Goodman. All are of the trolley type.

Main feeder cables are installed directly above the trolley wires in the same holder. Trolley wires are in three independent sections to localize trouble. Locomotives are inspected daily and given a weekly inspection by the assistant chief electrician, who fills out a report (opposite page). Inspections and minor repairs are made at the locomotive barns underground. A general overhaul is made once in eighteen months when the locomotive is brought to the electrical shop on the surface. It is first thoroughly cleaned, a steam jet being used for this purpose. The principal repairs are in the older type armatures and control. In newer locomotives a full magnetic contactor control has materially reduced the maintenance work formerly required. Contactor tips are changed about once in ten months. The older type locomotive gave trouble in the armatures and controller. Arcing is avoided in the new controllers. One of the new locomotives has been in service eighteen months and is in excellent condition, no major repairs having been necessary.

One factor in low locomotive maintenance is a good track system, which is methodically inspected at regular intervals. Rail bonds are inspected once every six months. On main lines, 0000 bonds are electrically welded to the tracks and cross connections made every 200 ft.; on branch lines, 00 rail bonds are in use. No trouble is experienced with the trolley suspension except occasionally as a result of blasting. A block signal system is in use and has been in service four years without trouble.

Much of the plate work is carried on out in the open—in the foreground is a feed spiral, and some sections of flotation cells are to be seen in the background

Miami Copper Company

Mine Locomotive Weekly Inspection Report

Units	Parts	Inspected	Remarks
Motor Serial	Goodman	1	
	Westinghouse controller end	1	
	Westinghouse opposite controller end	2	
Trolley	Wheel and bushings		
	Harp and pins		
	Socket and bolts		
	Spring and pedestal		
	Pole and hinge		
Fuse	Size fuse		
	Terminals		
	Box and cover		
Controller	Main cylinder		
	Main cylinder handle		
	Main cylinder shaft and bearings		
	Main cylinder contact segments		
	Main cylinder fingers		
	Reverse cylinder		
	Reverse cylinder handle		
	Reverse cylinder shaft and bearings		
	Reverse cylinder contact segments		
	Reverse cylinder fingers		
Res. Grids	Grids		
	Grid terminals		
	Grid spring supports		
	Grid frame bolts		
Motor	Brushes		
	Brush holders		
	Armature		
	Armature bearing commutator end		
	Armature bearing opposite commutator end		
	Commutator		
	Commutator fields		
	Main fields		
	Series fields—Goodman		
	Motor leads		
	Motor support, bolts, pins, cotters	1	
	Motor support, bolts, pins, cotters	2	
Head-Light	Lamps or carbons		
	Wiring and mechanism		
	Frame and fastenings		
Bumper	Supports		
	Bolts, lock washers		
Springs	Main drive (leaf)		
	Shackles		
	Supports		

Inspected by Time

Units	Parts	Inspected	Remarks
Gear Housing	Controller end		
	Opposite controller end		
	Covers		
Spur Gear	Controller end		
	Opposite controller end		
	Bolts, nuts, lock washers		
Spur Pinion	Controller end		
	Opposite controller end		
Bevel Gears	Controller end		
	Opposite controller end		
Brass Bushings	Controller end (2 each)		
	Opposite controller end (2 each)		
Brake	Hand wheel		
	Gear wheels		
	Gear wheel housing		
	Shoes		
	Shoe holder		
	Hair pins		
	Cotter pins		
	Bolts, nuts, setscrews		
	Levers and rods		
	Adjustment		
Journal Box	Guides		
	Bearings		
	Wool waste and oil		
Axle Bearing	Brasses		
	Wool waste and oil		
	Bolts, nuts, lock washers		

	Opposite controller end	Controller end	
Sanding Mech.	Lever		
	Tie rod		
	Valves		
	Pipe		
	Rubber hose		
	Pins and cotters		
	Holding spring		

Oil System	Oil pipes and caps		
	Grease boxes and covers		
	Oil boxes and covers		
	Wool waste		
	Oil can		
Wheels	Tires		
	Thrust collar inside hub		
Wiring	Trolley wheel to socket		
	Socket to controller		
	Controller to grids		
	Controller to motor		

Date

Hoist motors are inspected weekly, at which time all safety devices are also tested. One operator on each shift looks after all electrical equipment and changes contact fingers when necessary. Oil is changed in the motor-generator flywheel set once a year, the spent oil being used for lubrication by the mining department. Two electrically operated elevators are used underground, and these are serviced at regular intervals. The report form for crane and elevator inspection is shown in condensed form on the following page.

Each line section underground is protected from overload by a circuit breaker. This applies to the main feeder line as well as to each branch. One man and a helper on the day shift are engaged on trolley line work. On the

Miami Copper Company

Hoist and Elevator Weekly Inspection Report

Location.....
Make.....
Capacity.....

Inspection	Parts	Inspected	Remarks
Hoist Electrical	Motor		
	Controller and grids		
	Trolley wire and insulators		
	Limit switch		
	Solenoid brake		
	Wiring; lubrication		
	Trolley wheels		
Mechanical	Hook		
	Sheave wheels		
	Pins and bushings		
	Pinion, gears and bushings		
	Mechanical brake		
	Cable drum and bushings		
	Lubrication		
Cable	Cable		
	Chain		
	Hand rope		
	Hand chain		
Bridge Electrical	Motor		
	Controller and grids		
	Wiring; lubrication		
Mechanical	Wheels		
	Gears		
	Pinion		
	Bushings		
	Lubrication		
Carriage Electrical	Motor		
	Controller and grids		
	Trolley wire and insulators		
	Wiring: lubrication		
Mechanical	Wheels		
	Gears		
	Pinion		
	Bushings		
	Lubrication		
Elevator Electrical	Motor		
	Safety switches		
	Solenoid brake		
	Magnets		
	Contactors		
	Wiring; lubrication		
	Door switches		
Mechanical	Cage and counter weights		
	Drum and sheaves		
	Pinion or worm		
	Gears and bushings		
	Lubrication		
	Guides and shoes		
	Governor		
	Gate locks		
	Rope locks		
Cable	All cables		
	Hand ropes		

Electrical inspection by ..... Date .....
Mechanical inspection by ..... Date .....
Cable inspection by..... Date .....

other two shifts trouble is taken care of by the surface "trouble-shooters." Lights are on an independent circuit. Safety stations are provided with green lights that are on the trolley circuit.

Except for crane service all motors in the mill are alternating current. In the new installation, 300-hp., 6,600-volt, 187.5 r.p.m. synchronous motors are coupled directly to the pinion shaft driving the fine-grinding mills. These motors are started by being thrown across the line, and furnish 225 per cent starting torque. They are of all-steel welded construction. Some have been in service three months and have required no maintenance work outside of changing one faulty stator coil. Some idea of the conditions under which these motors are operating is afforded by the weights involved: ball mill, 87,000 lb.; mill liners, 51,900 lb.; 1½-in. steel balls, 65,000 lb.; pulp, 12,000 lb; total, 215,000 lb. There are six of these fine-grinding units. A spare motor unit is provided, together with ⅓ set of stator coils, a spare set of bearings, and two left- and two right-field coils. By avoiding starting apparatus and using an oil circuit breaker and push-button control, not only has first cost been diminished, but maintenance has been reduced to a minimum. This is an excellent example of the manufacturer's work in simplifying design and thereby reducing maintenance and making operating control simple.

Three synchronous 600-hp. motors drive turbo blowers and have been operated continuously for five or six years without trouble. Present blowers are to be replaced by low-pressure blowers. Six 28x20x42-ft. bowl classifiers have 10-hp. motors on bowl and 20-hp. motors on the rake drive. Two batteries of pumps consisting of six 4-in. Wilfley pumps are each Tex-roped to 25-hp. induction motors. This newer installation has been designed and installed to reduce maintenance to a minimum.

Motors in the crushing division have given trouble from overloading, resulting in bad burn-outs. To overcome this difficulty and to provide for increased ore tonnage, two motors are now used to drive one jackshaft, one at each end. A gravity feed lubricating system has also helped to overcome some of the operating difficulties mentioned before. Two 7-ft. cone crushers are in process of installation. One was in operation when I visited the plant. These units are driven by 250-hp., 440-volt, 500-r.p.m., squirrel-cage induction motors direct-connected by flexible coupling to the crusher pinion shaft. Push-button contactor control with reduced voltage starter and thermal overload relays is being used for these motors.

Mr. Luchessa commented upon the better results obtained by improving motor control equipment. He stated that thermal overload relays and thermal cut-outs are being used in all parts of the plant. By their use small motor burn-outs, a continual source of trouble, have been greatly reduced. Formerly fuses and overload oil dash pots were a source of trouble. During the last two years the newer equipment has given satisfactory results. Larger motors are protected by C-O induction overload relays. All circuits are also protected by C-O relays. In the crushing plant, speed reducers used upon the incline conveyors gave trouble, and this has been eliminated by replacing the motors by slow-speed, 214 r.p.m., 440-volt induction motors. These motors are coupled to an inclosed single-reduction herringbone gear and pinion, and have operated without a shutdown from motor trouble for five years. A motor-generator set supplying direct current for crane service has been in service for eighteen years without commutator or bearing trouble.

DUST

A cause of ill health, a contributor to the maintenance of a low social status and lack of self-respect, and an obstacle to efficient plant operation

BENKER has applied the name of *pneumonoconiosis* to the various forms of diseases of the lungs caused by the inhalation of dust. It represents two words from the Greek which mean "lung" and "dust." The kind of dust inhaled determines the type of pulmonary lesions. However, there is one pathological process which underlies all forms of lung disease, and this consists of a fibrosis or a replacement of the elastic tissue of the lungs by that of an unyielding scar tissue.

Probably the most important kind of disease of the lungs caused by the inhalation of dust is that which has been named *"silicosis."* This disease is caused by breathing air which contains a relatively large amount of free silica. The chief forms in which free silica is encountered in industrial processes are crystalline silicon dioxide, granite, quartz, and sandstone.

There are two tentative standards existing in regard to the dangerous quantity of free silica in atmospheric dust:

1. The South African experience established the upper limit of safety between eight and nine million particles per cubic foot of air.

2. The United States Public Health Service, in its research at Barre, Vt., found that the upper limit was somewhere between ten and twenty millions of particles per cubic foot.

These upper limits of safety are obviously dependent upon the percentages of free silica found in the atmosphere under consideration.

Classification of Dusts

The size of dust particles has much to do with whether or not they will cause trouble in the lungs. Larger particles may be neglected when considering this point. The words "large" and "small" are used here in a relative sense, for all of these particles are exceedingly small. For instance, the particles that are significant in considering the production of a fibrous reaction in the lungs range in size from 2 to 0.5 micro-millimeters in diameter (a micro-millimeter is the equivalent of 1/25,000th of an inch). Gibbs has classified dust particles according to size as follows:

Dusts—Greater than 10 m-mm. in diameter.
Clouds—from 10 to 0.1 m-mm. in diameter.
Smokes—from 0.1 to 0.001 m-mm. in diameter.

Although size of particles is important, the quality of the dust is equally of moment, *for there are both non-irritant and irritant dusts.* A physiologic classification of dusts by Dr. C. K. Drinker is apropos here:

I. Poisonous (from a chemical standpoint).
   (a) Lead, mercury, arsenic, and others. This kind of dust is taken up by the liver after absorption through the lungs or gastro-intestinal tract.

II. Non-poisonous.
   Organic—mainly the vegetable fibers, such as cotton, jute, and hemp (according to Landis these do not produce lung fibrosis).
   (b) Inorganic (mineral dusts)
      1. Non-silica-containing substances such as coal and lime. (No fibrosis.)
      2. Combined silica (silicates)—no fibrosis.
         Orthosilicates—clay.
         Metasilicates—talc.
         Trisilicates—feldspar.
      3. Harmful silica (crystalline silicon dioxide) granite, quartz, sandstone.

Mechanism of Absorption of Dust Particles

The lungs of persons living in large towns are always more deeply pigmented than those of persons who live in the country. On examination the cause of the pigmentation is found to be particles of carbon or other kinds of dust. The finer particles in the atmosphere are responsible for these changes, the coarser particles usually having been entrapped in the nose or the upper portion of the respiratory tract and usually later expelled by coughing. It is likely that particles over 2 micro-millimeters in size do not reach the lungs.

Normally the structure of the windpipe and the bronchial tubes is a defensive barrier. Dust is caught in the mucous secreted by these tubes and is wafted outward by the waving action of the small hairs of the epithelial lining of these tubes. It is said that recurrent colds lead to a shedding of the surface lining and an important defense is thus lost to the lungs. This circumstance is not without effect, since chronic catarrh of the upper respiratory passages has been found to be a frequent precursor of pneumonoconiosis.

In the ultimate structure or alveoli of the lungs, the possible fate of particles inhaled may be:

1. Going out the same route as that by which entrance was gained.
2. Removal by the blood stream.
3. Removal by the lymph stream.

The stages by which a particle may be removed from an alveolus are as follows:

1. By phagocytosis. This process is accomplished by certain kinds of cells which are given off by the blood-vessel walls when an irritant comes into that neighborhood. These

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free cells move into the alveolus or tiny lung space, and surround or engulf the foreign particles. The phagocytic cell then moves through the walls of the alveolus and probably back into the lymphatic circulation.

2. The phagocytic cell may then be carried into the lymphatic circulation and to the glands at the roots of the lungs. This may happen within 24 hours at first, but later collections of lymphoid material may offer obstruction to such migrations. These nodular collections may show as dense spots in an X-ray film. Later on they may become fibrous and show as dense strands in a film.

3. The phagocytic cell may migrate back into the blood stream going through the blood vessel wall.

Haldane and Mavrogordato have proposed a theory, which, simply stated, is as follows: The question of whether or not a given dust will cause a disease process in the lungs (aside from the particle size and poisonous chemical character of the dust) is probably dependent upon the difficulty of absorption rather than upon the massive deposition of material. In illustrating this theory, experimental animals were caused to breathe carbon dust. The lungs showed a definite clearing after a few months; this was not true when silica was breathed; probably it acted as an irritant. This caused a circulatory disturbance by which the particles became coated with serum. Because of the lack of absorptive power of silica particles, the consequent circulatory disturbance and production of serum, the particles of silica were not taken up by the white blood cells and removed from the lungs, as had been the case with carbon particles. This behavior of different kinds of particles was responsible for the working out of the theory as stated.

Probably the best analysis of present-day opinion with regard to the effects of dusts upon the human body has been made by Dr. E. L. Collis in the report of the Fourth International Medical Congress on Industrial Accidents and Diseases:

1. Dust particles which have reached the alveoli are there engulfed by cells originating from the epithelium lining the alveoli and are carried within them into the lymph channels of the lungs.

2. Particles of some kinds of dusts are more readily engulfed than those of others. Organic particles, such as coal, are most readily taken up, and particles of silica least readily; but when certain cells have been, as it were, educated in the function of absorbing dust particles through the presence of, say, coal dust, they more readily take up particles of such substances as emery, carborundum, and silica.

3. Particles of certain dusts, such as carborundum, when engulfed and carried into the lung tissue, remain inert, and produce no reaction.

4. But silica particles slowly dissolve within and react chemically upon the cells containing them, causing cell death and mummification.

5. The dead, mummified cells collect in and block up the lymph passages and glands; here they disintegrate and distribute the dissolved silica, which reacts with the surrounding tissues.

6. The final result of the reaction is the formation of scar tissue as a solid mass of material which in time replaces the normal alveolar structure of the lungs; the condition is one of silicosis.

7. All the various stages through which silicosis advances can be detected by X-ray photography.

8. The same results follow whether fine silica dust be artificially placed in the body or soluble silica be injected, but in the latter case the disintegrating changes take place more rapidly.

9. Dead tissue so caused forms a medium in which tuberculosis germs readily flourish.

10. When soluble silica is introduced into the blood stream it reacts with liver cells, causing scar tissue there, and also in kidney cells.

11. Statistical records indicate that Bright's disease as a cause of death is unusually prevalent among certain occupational groups exposed to silica dust.

12. Clinical observations have shown that (a) in many persons who have been exposed to silica dust for a period sufficiently long to enable the dust to gain access to the lungs, the silicotic process continues to advance after complete withdrawal from exposure; (b) the silicotic process may progress to fatal termination without the effect of any intercurrent disease; but (c) a silicotic patient is particularly liable to fall a victim to tuberculous infection; (d) tuberculous infection in a lung containing silica particles hurries the process of silicosis; (e) pulmonary tuberculosis in silicotic subjects (depending upon the amount of scar tissue present) runs an unusually rapid and fatal course; but (f) when silicotic persons are protected from exposure to tuberculosis infection, the occurrence of tuberculosis among them is minimized; hence tuberculosis in such persons appears to result from fresh infection during adult life; (g) tuberculosis infection from silicotic persons seems to be less potent than usual for infecting nonsilicotic persons.

How Much of the Inhaled Dust Is Retained?

Drinker, Thomson, and Finn have noted in an article published in the *Journal of Industrial Hygiene* for January, 1928, the following effects:

Suspensions of freshly generated zinc oxide fume (particles of about 0.4 micron) of Kadox (a zinc oxide powder with particles about 0.15 micron) and of marble dust (particles about 0.3 to 6 microns) were set up in a 1,600-ft. gas cabinet.

The subjects, seated outside the cabinet, inhaled the air from within and exhaled through an electric precipitator into a 125-liter spirometer.

The percentage retentions for all three suspensions averaged 55, with a standard deviation of 9.4. The concentrations inhaled varied from about 50 to 450 mg. per cubic meter, the exposures from five to forty minutes, and the rates of breathing from six to eighteen respirations per minute.

Preventive Measures

Kober discusses this important phase of the dust problem under six headings:

1.—*Prevention of Dust Formation.* A number of important processes in industry can be properly controlled by the application of oil, sprays of water, or jets of steam. This method of protection is especially applicable to the metal, lead, and pottery industries, rock drilling, mining, blasting, stone-crushing, cutting, and grinding.

Several investigators have emphasized this method of control, believing that proper usage and adaptations would result in the abolition of some of the more severe diseases arising from exposure to dust.

Another important application of wetting processes is prevention of disastrous explosions of coal dust in mines.

2.—*Prevention of Dust and Fume Diffusion.* Protection is accomplished under this head by the inclosure of machinery or operations in air-tight cases. This method, however, sometimes gives rise to great difficulty, because many processes cannot be wholly inclosed and still be effective.

3.—*Removal of Dust and Fumes.* Much has been accomplished by devising systems of mechanical exhaust ventilation, which remove dust and fumes at the point of origin. Various codes have been invented which lay down specific rules and definite provisions for removal of dust and fumes by the proper construction of benches, tables, and other furniture with reference to hoods and other section apparatus.

A very important point in the arrangement of this type of protection is that provision should be made to carry the dust and fumes away from the face of the worker.

It is not within the province of this article to give details as to the working out of various exhaust systems. (See Safe Practices Pamphlet No. 32, "Exhaust Systems.")

4.—*Collection of Dust and Fumes.* Where poisonous fumes and gases exist, methods of collection consist of condensation, absorption by water or chemicals, destructive distillation by heat in a closed vessel, combustion of gases that can be burned, and, finally, the discharge of gases into the air above the working level. Valuable byproducts are also recovered by condensation and absorption.

An example is the value of blast-furnace and coke-oven gases, which are used for fuel, for heat and power, and also sulphuric acid fumes, which are collected and made into sulphuric acid.

Certain dusts which have no especial value can be passed through a tower and precipitated by means of fine water spray. Where the dust is of value, it may be collected in suitable tanks under water for ultimate recovery of constituents.

Large particles of dust are usually collected by a so-called cyclone separator in which the dust is collected by centrifugal force. Mechanical filtrations have been accomplished by the use of mechanical knocking devices, through textile fabric or wires of different meshes.

Electrical precipitation as developed by Cottrell has been found efficient in precipitating and collecting certain kinds of dust.

5.—*Masks and Respirators.* It should be borne in mind that masks and respirators are usually uncomfortable to those who wear them. There is an endless number of these devices upon the market. The best respirators so far designed are intended to filter out dusts and fumes by means of sponge, cotton, wool, gauze, or other material. Most of these are efficient for a certain period, after which they become clogged and must be replaced. Masks are more reliable and afford a greater amount of protection under ordinary conditions. (See Safe Practices Pamphlet No. 64.) Kober states that working conditions should be so nearly perfect as to obviate the use of respirators. Until this is accomplished, he says their employment should be encouraged.

6.—*The Cleaning of Workshops.* It is impossible to set up exact standards which will apply to all conditions and all industries. It is also well to emphasize the fact that no amount of ventilation can do away with the necessity for frequent and systematic cleaning of plants. Shops should be swept daily after work has ceased, using damp sawdust or other material and having windows open widely. Some industries use a vacuum system for cleaning and dusting, and this should always be encouraged.

Under certain conditions, cement floors made with a considerable incline for drainage have been useful in facilitating washing.

Feather dusters ordinarily do not remove dust, but merely redistribute it. Moist cloths have been found efficacious for removing dust from surfaces of furniture. "Dust oil" has not been found efficient, as usually it only allays the dust and does not remove it.

Dust Respirators

Through the U. S. Bureau of Mines, S. H. Katz, G. W. Smith, and E. G. Meiter conducted a study on the construction and filtering efficiency of dust respirators. The conclusions reached were as follows:

1. The efficiencies of industrial dust respirators in restraining tobacco smoke range from 5 to 33 per cent when the air is passed at a rate of 32 liters per minute. A gas-mask canister with two filters of absorbent cotton showed 63 per cent efficiency. The Fogler flat felt filter was most efficient, showing 97 per cent.

2. The efficiencies against silica dust floated in air range from about 9 to 70 per cent for dust respirators, or about twice the efficiency against the tobacco smoke; most of the silica particles were 1 micron in diameter, or four times the diameter of the tobacco-smoke particles.

3. As dust particles most injurious to miners, stone workers, and many others engaged in dusty trades are about 1 micron in diameter, respirators, if worn, can prevent a considerable amount of dust, but not all of it, from being inhaled.

4. Although the laboratory study has shown that most dust respirators are not highly efficient in removing tobacco smoke (very difficult to arrest) from air, a filter that removes 50 per cent of the tobacco smoke from air flowing at a rate of 85 liters per minute is very efficient in restraining the ordinary dusts encountered in industry and also the smokes (such as those from burning wood and other carbonaceous material) that city firemen encounter. Hence, the Bureau of Mines adopted a 50 per cent efficiency test against tobacco smoke as a standard requirement (in addition to others) for the approval of respirators or gas masks designed to afford protection from smoke or dust.

5. Because the laboratory tests of the dust respirators were severe, the low efficiencies given do not indicate the general effectiveness of these respirators under all industrial conditions. Much of the dust encountered in industry is less difficult to arrest; the over-all efficiency of the respirators in actual service may thus be correspondingly higher. The tests therefore show that as a rule the respirators are of much value in removing injurious dust from inspired air.

6. The discomfort caused by respirators covering the face —the heat generated, the irritation of the skin in contact with the respirators, and the resistance to the flow of the air breathed—are the most serious disadvantages of respirators. Resistances of industrial dust respirators to air flowing at 85 liters per minute were 0.25 to 1.5 in. of water. The Fogler flat felt filter had a resistance of 2.25 in. and the gas-mask canister 3.6 in.

7. A man wearing a gas mask can work hard only about half an hour; then the extra effort caused by the resistance to breathing compels him to stop to rest or greatly reduce his exertion.

The resistance of the dust respirators, although causing some discomfort, does not seriously interfere with a man's exertions until the filter becomes clogged with deposited dust and the resistance correspondingly increased. The filter must then be cleaned or freed of dust or be replaced by a fresh one.

8. Filters of various fabrics, including cheesecloth, canton flannel, unbleached muslin, closely woven bleached muslin, filter paper, and absorbent cotton, all made for test purposes so as to expose exactly 100 square centimeters of filter area, were tested against tobacco smoke and against silica dust in air flowing at a rate of 10 liters per minute. Each material was tested in a single layer and in multiple layers. Results showed that each layer of fabric (in effect) removes about the same proportion of smoke or dust that penetrates to it before the filters become clogged or altered by deposits of an arrested material, such as silica dust. Consequently, when the efficiency of a single ply of a filter is known, the efficiency of any multiple-ply filter of that material may be calculated.

9. Silica dust clogged filters rapidly and increased the resistance to air flow, but some materials were more resistant to clogging than others. The dense filters of paper or closely woven muslin clogged most rapidly; filters of loose texture like cheesecloth or absorbent cotton clogged the least.

10. The efficiencies of the filters were increased by clogging with dust until eventually many filters gave an efficiency of 100 per cent.

11. Tobacco smoke did not clog filters, and there was no increase in efficiency as the smoke was deposited.

12. A few tests were made with woolen fabrics, but they proved to be no better as filters than cotton fabrics of similar texture.

13. The efficiency of the filters decreased somewhat with an increase in the rate of air flow. Sometimes a cotton fabric with a nap showed a decrease after humid smoke had wet it and the moisture had caused the fibers of the nap to adhere together.

14. The resistance of the filters to air flow increases in proportion to the number of plies of fabrics after the first ply. The first filter layer shows a somewhat higher resistance than the additional ones.

15. The resistance of fabric filters to air flow is very nearly proportional to the rate of air flow.

16. Air filters of high efficiency can be made with a suffi-

cient number of plies of material that has a low efficiency per single ply—cheesecloth, for example. Such filters have less resistance to air flow than equally efficient filters made of fewer plies of the higher-efficiency materials, such as closely woven muslin.

17. The thicker filters of loose-textured material clog less rapidly than equally efficient filters composed of fewer plies of tightly woven material.

18. A new type of dust respirator was designed and constructed according to the principles brought out in the tests. This respirator consists of a large filter of canton flannel made into a cap or turban for the head. Air filters through the canton flannel to the interior, passes through a check valve, and is then conducted through a rubber tube running over the forehead and between the eyes to the nose, which is covered with a small rubber nose cap. At an air flow of 85 liters per minute the efficiency of this respirator was 58 per cent against tobacco smoke and 93 per cent against silica dust.

19. The data presented and the principles outlined may aid manufacturers in improving dust respirators.

20. *Although the use of respirators should be encouraged among workers in dusty industries, a respirator cannot be considered a final safeguard.* In mining and in other industries efforts to prevent the formation of dust and its distribution by the air, by the use of hollow drill steel and water, and by sprays on the undercutting machines, should be continued.

The National Safety Council has previously called attention, in the reports given by A. L. Watson, chairman of the Industrial Poisons Committee (at the Eleventh Annual Safety Congress in 1922), to desirable qualifications in respirators:

1. Lightness in weight.
2. Automatic adjustment to facial lines.
3. Comfortable contact edges which will not irritate.
4. No obstruction to vision.
5. No interference with wearing goggles.
6. No serious resistance to breathing.
7. Relief valve that will not clog.
8. No interference with chewing and spitting.
9. Relief valve placed so as not to blow dust in eyes.
10. Headbands durable and easy to fasten.
11. Inflation valves easy to operate if contact is pneumatic.
12. Durability of parts requiring adjustment.
13. Little attention required.

More recently Barreto, Drinker, Finn, and Thomson tested the efficiency of dust masks and respirators and emphasized the following points:

1. Masks for protection against dust and fume particles must be provided with effective filters, preferably of a fibrous nature and with large cross-sectional area. The materials used in gas masks for protection against poisonous gases are ineffective in removing particles of dust and fumes.

2. The efficiency of masks of large or small area can be very greatly increased by plugging the surface meshes with a freshly generated, finely divided fume like zinc, magnesium, or aluminum oxide. If the filtering area is small, plugging quickly increases the resistance to prohibitive figures; but masks with large area (800 to 1,200 sq.cm.) can be plugged to give perfect protection against finely divided lead fume and over 97 per cent against tobacco smoke. At the same time, the resistance to air flow can be kept below 30 mm. of water pressure measured at 85 liters a minute.

Other Methods of Protection

Dr. R. C. Williams calls attention to the following general measures for protection against dusts and fumes:

1.—*Industrial Law.* The foundation of industrial hygiene and sanitation rests on industrial law. The history of the control of industrial hazards is the history of the enactment of industrial laws. Industrial laws must be scientifically sound. Fundamentally, the law is for the protection of the worker, but, on the other hand, in forming such a law the effect on industry and the cost of production must be considered. The elimination of all dustiness in the work processes where there is a dust hazard may be desirable, but there is no scientific reason for such a requirement if the dust itself is not a specific poison.

2.—*Law Enforcement.* Industrial laws are valueless unless enforced. The method of law enforcement in industry is usually through factory inspection and the actual checking up of the efficiency of protective devices. Competent factory inspection insures the control of industrial hazards and the maintenance of acceptable sanitary conditions.

3.—*Education.* The worker needs to realize the danger of certain health hazards as well as does the employer. Protective measures may be required by law and provided by the employer, but if the worker does not understand the necessity for their use much of their protective value is lost. Wholesome, common-sense education is the means by which the need for intelligent use of protective measures is impressed upon the workers.

4.—*Scientific Study of Industrial Hazards.* The correct basis of industrial law rests on comprehensive scientific understanding of the hazards that are to be controlled. Proper control and prevention of the health hazards of industry and their effect upon the health and physical condition of the worker can be obtained only through careful and thorough scientific investigations. The maintenance of adequate industrial sickness records by employers in order to determine the cause of sickness among workers, and to gage the efficiency of measures used to reduce health hazards, is an important part of the study of industrial hazards.

Methods of Dust Collection for Study

Methods by which dust may be collected and studied as to chemical content, size of particles, and amount per unit of air have been the cause of much research and investigation. These methods may be briefly summarized as follows:

Settling usually produced a piling-up effect so that the counting of separate particles is impossible.

Counting—An efficient jet dust counter has been devised by Owens.

Filtering has long been used, especially by the Bureau of Mines; different substances have been used for the filter, such as cotton, nitrocellulose, glass wool, paper and alundum crucibles of the insoluble type, and sugar as the best example of the soluble type. The difficulty with filter collectors is that they clog and resist the air flow, thereby preventing the possibility of getting the true quantitative dust content of the sample being tested.

Scrubbing methods (so-called because of the admixture of the dust particles with water) are much used because of the cheapness of water. The Drinker collector is an efficient kind of scrubber collector.

The U. S. Public Health Service and the U. S. Bureau of Mines have recently made use of an apparatus in their field work, called an impinger. By means of this instrument the air is impinged at a high velocity on a wet surface and then bubbled through a layer of water. Large volumes of air can be sampled and the efficiency has been found to be between 93 and 96 per cent, according to conditions.

Electric precipitation has been practiced for some time, the most notable example being the Cottrell precipitator, used extensively to collect smoke. A modification of the Cottrell device represents the best type of electric precipitation collector and one from which the particle size may be studied, as well as the chemical constitution of the dust.

Wherever there is a noticeable amount of dust produced in a given industrial process, the important steps in the investigation of the dust hazard would be:

1. The quantitative estimation of crystalline silicon dioxide in the sample of air breathed by workmen.
2. A chemical analysis of the dust sample.
3. A computation of a frequency distribution of the particle size.
4. Examination of workmen for physical effects.

The U. S. Public Health Service has recently published a monograph entitled "The Health of Workers in Dusty Trades." The method used in this study is here outlined:

1. Physical examinations for the purpose of determining general physical conditions. Data from this procedure gave important physical differences; the industrial rating of the individual; the group to which he belonged; and, lastly, aided in the selection of cases for special study.

2. Special physical examinations to determine the problem of specific diseases of the respiratory system. This entailed a special study of lung pathology resulting from dust exposure.

3. Sickness records of the nature and severity of disabling illnesses. These record cards showed all absences from work lasting two days or longer. Diagnoses were made in all cases.

4. Occupational environment. Chemical and petrographic analyses of all dust samples.

SUMMARY

Dr. Edgar L. Collis calls attention to the following points with reference to exposure to dust:

1. Inhalation of all forms of dust is accompanied by diminished power of chest expansion.

2. Diminished power of chest expansion so produced is accompanied by high blood pressure.

3. Animal dusts (apart from the presence in them of disease germs), when inhaled, produce relatively fewer effects than do vegetable and mineral dusts.

4. Vegetable dusts, when inhaled, tend to produce a type of chest affection best described as asthmatic.

5. Of mineral dusts, those composed of calcium salts are least injurious.

6. Inhalation of mineral dusts which do not contain free silica tends to produce irritation of the upper air passages and respiratory diseases other than a fibrous reaction.

7. Inhalation of mineral dusts which contain free silica is associated with an excess of scar tissue formation, an excess which bears a direct relation to the amount of free silica present.

8. In general, dusts appear to be more injurious as their chemical composition differs from that of the human body or from the elements of which the body is normally composed.

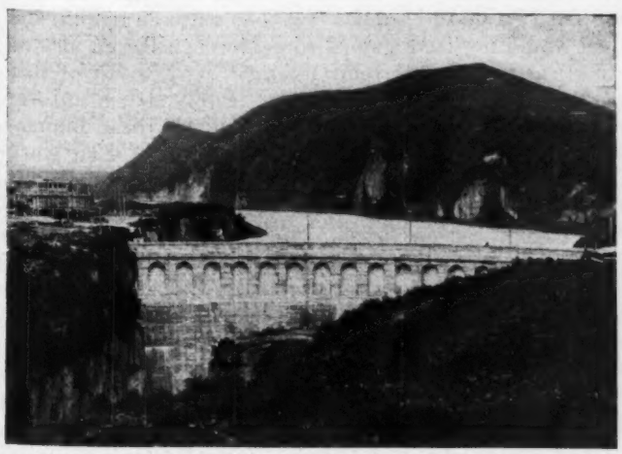
Non-metallics in the Boulder Dam Region

NON-METALLIC mineral deposits in the region served by the Los Angeles and Salt Lake railroad were discussed recently in the "Union Pacific Magazine" by B. M. Prescott, who has made a special study of this region. A large deposit of salt bordering the west side of Rio Virgin Valley, 4 miles south of St. Thomas, Nev., is being mined and shipments to various markets are being made. Magnesite deposits are also found near St. Thomas, in the Virgin River Valley. Near Apex, Nev., is a commercial deposit of pure limestone estimated to contain twenty million tons. Five miles from Crystal, Nev., are deposits of silica rock which, when crushed, yields a product suitable for glass making.

In White Basin, near Las Vegas, Nev., are colemanite deposits that have been developed by the West End Chemical Company. Near Boyd, Nev., 15 miles south of Caliente, the American Clay Company owns a large deposit of kaolin. At Nipton, Calif., shipments are being made from a feldspar deposit. Near Oasis, Utah, infusorial earth is mined and shipped to Brooklyn, N. Y. In the northeast corner of Beaver County, Utah, 29 miles from Black Rock, a large deposit of sulphur is being worked and shipments are being made. From the vicinity of Arden, Nev., gypsum deposits have supplied gypsum products for a number of years.

The Boulder dam development is expected to make industrial mineral deposits in this region more valuable and to attract attention to further prospecting for other deposits.

New Zealand Electric Project Uncovers Prehistoric Forest



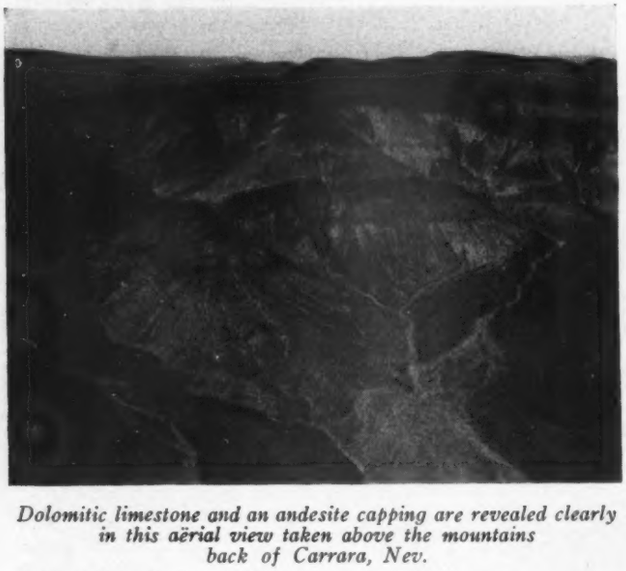
View of the Arapuni dam, recently completed as a part of the power development of the New Zealand government. This 150-ft. diversion dam turns the Waikato River out

of its present gorge into a former channel serving as a conduit to the penstocks. When turned into this old channel, the water unexpectedly washed through a deposit of pumice, bringing to view skeletons of a forest buried in past ages. About a mile below the point of diversion the water is returned to the present river channel through 12-ft. diameter penstock tunnels which have a head of 175 ft. Ultimate plans call for eight penstocks, each operating a 15,000-kw. unit. The principal use of the power is for the city of Auckland, served by a 110,000-volt transmission line about 104 miles long.—*Engineering News-Record.*

Spotting Mineral Deposits By Airplane

A. J. MOORE
Mining Editor, Nevada State Journal

TO LOOK DOWN 5,000 or 6,000 ft. from an airplane and determine for certainty that outcroppings carry gold, silver, copper, or lead, or that they are even mineralized, may be improbable, but the airplane is of inestimable value in saving prospectors useless work and hardships. A mountain range viewed from the air presents a very different aspect than when viewed from



Dolomitic limestone and an andesite capping are revealed clearly in this aërial view taken above the mountains back of Carrara, Nev.

a valley or canyon. From the airplane the whole structure may be seen, whereas from the surface the range of vision is limited, and no general impression of the whole is obtained.

Military operations during the World War proved that the eye of the camera could discern things unseen to the naked eye. With a proper lens, photographs may be taken from a height of from 5,000 to 7,000 ft. These, when enlarged, may show footprints in sand or grass. Such photographs of an outcropping in a mineralized region would give a detailed picture of the formation. The geologist, by elimination, could then decide to which portions of the range the prospector should confine his investigations.

Air photography progressed rapidly during the war, and special cameras were devised. A camera was usually suspended below the airplane and swung on a universal joint, so that it maintained a true level regardless of dip or tilt. The shutter worked automatically and was so synchronized with the speed of the plane that each exposure joined the previous one. The camera was focused to, say, 6,000 ft. When the films were developed and enlarged, experts could read from them every detail of the landscape. This, of itself, became a profession. Men became experts in the reading of topography. A geologist can likewise read the photographic prints and designate each formation as accurately as though he had tramped over the outcropping. From such readings, the most promising ground can then be inspected at close range, and samples taken, the assays of which will determine the valuable mineral content.

My first experience of this character was a flight over Weepah, Nev. About the time of the Weepah boom, the late R. J. Leonards stopped off at Reno on an airplane trip from Los Angeles to Las Vegas. He had with him Frank Eichelberger, now in charge of construction of the 350-ton mill of Base Metals Mines, in British Columbia. I must confess that I regarded the trip to be a publicity stunt more or less. The high standing of Mr. Eichelberger and his earnestness in the subject of geological study from the air, however, caused me to lend a patient ear to his words. He predicted that much of the mine prospecting done in this country in the near future would be started in the air, ground inspection being made subsequently.

A week later the Weepah boom had assumed such proportions that it was advisable that I, as a mining editor, should go to the camp. I wrote to R. J. Leonards that I wished his airplane was at Tonopah, so that I might look over the country from the air. Back came a wire stating that the airplane would be at my disposal during the week of my stay in Tonopah. I flew not only over Weepah but down to Goldfield and back north to Camp Gilbert, covering about 50 miles back and forth several times, and did it all within two hours. I could not have covered the same ground by surface methods within a month, and then would not have gained so comprehensive an idea of structure, faults, and vein systems. As a result of that trip over the Monte Cristo range, I was able to inform old prospectors of conditions prevailing; these impressions they later substantiated in the course of their work on the range. For instance, I told them of a lime belt that was about four miles long and in almost a straight line, except for one break. Later, a prospector found the continuation of the limestone a few hundred feet to the east, whereas he had previously looked for it to the west. From the air, that break did not appear to be more than 75 ft. As a matter of fact, it was more than 800 ft. Since that day I have been air-minded.

Little gulches and breaks in the structure that make the work of the prospector difficult when tramping the ground are as clear as a picture from the air. The range of vision on the ground is quite limited; whereas from the air it is 25 miles or more. This is well illustrated by the view obtained of the range near Millers, Nev., as

A large deposit of diatomite discovered from the air

one sweeps out over the flat on the approach to the mill of Tonopah Mining. Riding along the flat in an automobile, the ridge appears much broken. From the air the continuation of the backbone of the structure is apparent. The range of vision of a prospector in one of the gulches along this structure is limited, and he may form an entirely incorrect opinion of conditions. On looking down on a range of mountains, the various canyons and gulches appear as though someone reached down and, with a big shovel, scooped slices out of the mountainside. In reality this is what nature has done. The wearing away process during ages has broken down the weaker strata, and the top and other portions of the structure have been carried out onto the flat, which at one time was a deep valley. From the air, one notes the sweep of the flood waters as they gather along the ridge top, gaining in volume and force as they rush down the mountainside, later spreading out and forming rivulets on the flat. This is why rich float is often found far out on the flat. The prospector has a hard time following the float to its source—to the point of the range from which it was broken. In some instances, this hunt has gone on for years before the broken point and the ore in place has been found. From the air, the course of the water that carried the float so far from its source may be more easily traced.

The photographs I obtained were taken with an ordinary camera from the window of a Lockheed-Vega airplane of Nevada Airlines on a trip from Reno to Las Vegas, traveling at an average speed of 140 miles per hour. It was simply a pleasure trip, not one of exploration. With a special camera, equipped with a more powerful lens, enlargements would show every detail of geological formations, and the geologist experienced in such work could distinguish from such photographs many of the structural features of the ground.

Occasionally a formation is so marked and distinct, however, that even the ordinary camera reveals it. Such detail was obtained in the accompanying view taken on the trip at a point above the mountain and well back from Carrara. The line of demarcation between the lime formation and the andesite, and the contact also, are so plain that a novice can readily distinguish them. The only knowledge of air photography needed is an understanding that the black spots in the center near the bottom of the photograph are shadows and not andesite or iron cappings. The novice may know that the black covering is either an iron or andesite capping. Investigation, later, proved the capping to be andesite, and the filling a dolomite lime. The first close inspection showed that the lime filling was mineralized. The gold content ranged from a trace to $5 per ton. Further prospecting revealed a higher content.

On the same trip, about 200 miles northeast from the gold discovery, a large deposit of diatomite was noted, the face of which was badly stained from erosion from the surface. The value of this deposit, which is shown in the other illustration, can be determined only by tunnels. To be of commercial value it must be pure. Had this been a real exploration trip, the airplane would have circled around the deposit, and photographs would have been taken of the canyons and approaches. From these photographs a prospecting party could be directed, and days of scouting saved in reaching the deposit.

Airplanes can be used to good advantage in Nevada in tracing structures, noting faultings, and solving vein systems. Few mountains of the state do not have near at hand a dry lake, a valley, or an alluvial deposit that affords a safe landing field. Particular note was made on a trip by airplane from Reno to Los Angeles, Los Angeles to Las Vegas, and from there to Reno that at no time would it have been impossible to glide from an elevation of 13,500 ft. to a fairly safe landing. True, one might break up the airplane to some extent, but with little danger of serious injury to occupants. Dry lakes afford particularly favorable landing spots. The only objects to avoid in landing on the desert are rocks and heavy sage brush.

The Canadian government maintains several airplanes for the exclusive use of the engineers of the Department of Mines. On receipt of news of a new discovery, the Canadian Department of Mines immediately sends its engineers into the district. Surveys are made, and reports published at once for the benefit of the public. These reports contain information relative to geological formation, character of ore, and assay values, as well as directions for traveling to the new camp and information concerning food, water, and fuel conditions.

In contrast to this, the U. S. Bureau of Mines has no airplane. The Alaska Aerial Survey Expedition used airplanes borrowed from the Navy and cameras borrowed from the Army. In the State of Nevada, which produced over $36,000,000 in minerals in 1928, and which is noted for its wide open spaces, only one mining man owns an airplane. This condition will soon change. Business men will take to the airplane much more enthusiastically than they did to the automobile a few years ago.

Lead Refining at Bunker Hill Plant

IN HIS address at the Spokane meeting of the A.I.M.E., on operations at the Bunker Hill & Sullivan plant, A. F. Beasley, superintendent of the plant, gave interesting data on refining operations. The refined lead produced for each man employed in the refinery is 4.2 tons daily; average life of dross kettles is 3½ years; and the average life of the desilverizing kettles is 540 heats. The number of retort-hours per 1,000 oz. of gold and silver produced is 1.8. In the same operation 325 lb. of litharge is produced for each 1,000 oz. of the precious metals. In the silver retorts, 95 lb. of zinc is condensed each hour. The average life of retorts is 60 heats. In the refining of lead, 200 lb. of coal is used for each ton of metal produced. This includes separation and refining of the silver and gold contents.

Open-Pit Salt Mining in Utah

Operations in the Bed of a Prehistoric Sea, Begun by Chicago Business Men in 1926, to Be Materially Expanded—Mechanization and Method

ABOUT 250 miles south of Salt Lake City, Utah, where Father Escalante stopped to replenish his stock of salt in 1776 during the course of his peregrinations over the West, where John C. Fremont, the trail-blazer, journeyed numerous times for the same purpose, and where the Mormon pioneers started operations eighty years ago, preparations are being made by Great Western Salt to expand production. Since its organization in 1926, the company has specialized in the production of rock salt for livestock feeding, but it is now branching out into the business of making a table and dairy salt. About $100,000 has been expended in equipping the quarry and building a 3-mile branch railroad line from the Denver & Rio Grande Western and extending a power line.

On the Great Western Salt property, northeast of Salina, is said to be the most extensive rock-salt deposit in the world. The outcrop of this deposit is a mile and a half long and a half mile wide. This deposit, evidently the residue of a prehistoric sea, lies between two limestone walls. Open-pit mining is practiced, so that cost of extracting and preparing the product for the market is negligible, and present low costs are to be further reduced, when demand expands, by installing either an electric or a steam shovel.

Eight-foot holes are drilled into the mass and loaded with black powder. Frequently 1,400 to 1,500 tons are broken with one round. At present a face of rock salt 60 ft. high is being mined. The area of the quarry embraces more than an acre. The depth to which the deposit extends is unknown. Holes put down for 100 ft. have penetrated salt the entire depth.

A Worthington six-drill compressor furnishes air for drilling. Cochise drills and paving breakers are used for drilling and breaking up fragments of salt. The mineral is loaded into cars and hauled by horses to the plant, where it is crushed and screened and compressed into blocks for shipment. A Universal jaw crusher, capable of handling 300 tons every ten hours, is used. Tyler Hum-mer vibrating screens grade the product. The coarse is sacked and the fines are compressed into blocks in a presser capable of turning out four 50-lb. blocks every minute. Output during 1929 will total 400 carloads, compared with 200 carloads for 1928, according to Earl S. Wright, general manager.

A high-grade table salt is now being made by Great Western Salt. This will be derived from the brine lakes that have been formed during the course of quarrying by the drainage from springs and the surface runoff. Unwittingly, the early developers of the deposit aided this operation. A hole was drilled in the center of one of the lakes, which they thought would furnish drainage when the underlying country rock was struck. Instead of forming an outlet, an artesian flow was struck that increased the supply of water and the size of the lake.

The solution from the lake and the brine caverns, carrying 27.5 per cent sodium chloride, will be led through iron pipes to a cement tank, 50x60 ft., in a specially constructed building with sides of glass so that sunlight may assist the process of evaporation. Around the top of the tank is a 2-in. pipe, perforated with small holes. The gravity fall forces the brine into the air. Aëration promotes evaporation of the water, and the brine falls back into the tank. Automatic rakes pull the crystals from the top of the tank into a rotary kiln, where the salt is dried.

From the drier, the salt is sent to roll crushers, where it is pulverized and screened into different sizes for sacking. Having a supply of brine right on the surface will enable the company to make salt much more economically than in the East, where water has to be pumped into salt deposits at depths ranging from 1,000 to 2,000 ft. and the brine then lifted back to the surface. Two carloads a week will be shipped by the company at first, according to Mr. Wright. As demand grows, output can be augmented, as the supply of brine is large enough to make possible an increase in operations to several times the present capacity. At any time, brine reserves can be further enlarged by drilling other wells or piping more water from available springs.

Iron pipe is used throughout the plant. If iron pipe is kept full at all times, it deteriorates little more quickly than if filled with fresh water. Filled partly, the pipe soon becomes corroded. Valves must be placed flush with the end of the pipes to prevent rusting. Depreciation of plant machinery is very rapid, necessitating re-equipment once every five years. Tools kept in supposedly tight chests become rust covered in a few months.

The company has three buildings on its ground at the quarry: The structure in which the aëration equipment is installed measures 60x120 ft.; the storehouse 40x60 ft.; and a machine shop, 15x25ft. At Salina, the company has a superintendent's house, a clubhouse, an office, and other buildings.

Development of the project has been financed by Chicago men headed by the Zimmer Brothers, representatives of Fritzsche Brothers, manufacturers of essential oils and preparations. B. F. Zimmer is president and Charles O. Sethness, vice-president. Mr. Wright is secretary and treasurer as well as general manager.

COMMENT AND CRITICISM

When Agriculture Wins Over Mining in Arizona

To the Editor of "E.&M.J.":

The recently attempted rape of the manganese prospector and miner is only one example of unfairness and discrimination by the government against the miner in general. What about the rights of the miner when they conflict in the slightest with the possible rights of the farmer! It is the usual thing that agriculture wins against mining, no matter how strong the case of the miner may be.

As proof I will cite two cases that happened in the Warren mining district, in Arizona. I was connected with a small company that was trying to patent four mining claims. They were practically surrounded by other patented claims, and we thought that no difficulties would be encountered. What a fight we had! The land office blocked and fought us at every move upon mere technicalities. Upon cross-examination by our attorney, the government engineer, when asked if this ground were good grazing land, said, "No! A self-respecting cow would not be seen on the ground." In a nutshell the proposition was this—we were asking the United States government to sell us land at $5 per acre when the best the agriculturist would pay would be $1.25 per acre.

The government's refusal was not even good business, to say nothing of justice. Good business would say, "Here we are being offered $5 per acre for land that is not even good for grazing land. It has not a stick of timber on it; there are no dam sites; there is no water; in fact, there is nothing of value on it. If it has any value at all, it lies in its mineral possibilities. At $5 per acre it is bringing a big price. Then, too, as soon as this ground is sold or patent issued to it, it passes from federal ownership and becomes a part of the State of Arizona, which state will immediately assess it at $750 per claim, or $36.30 per acre. The state will receive taxes from it and the owner will have a secure title. It is good business for all parties concerned."

Instead of such a policy, in many instances through the years gone by, a very different one has been followed. Patents have been issued and officials have tried to have them set aside on the ground of fraud, charging that the ground was non-mineral and had been secured from the government under false pretenses. Some of this very ground has produced millions.

Far more unpatented than patented claims are to be found in the Bisbee district. One reason is that the law is such that a strict technical interpretation makes the issuing of patents almost an impossibility. This applies to other districts as well. Every once in a while a broad general interpretation is given these laws and patents are issued, but between times there are lawsuits, investigations, and hearings, and the poor prospector or miner has learned that it is impossible for him to get a patent. It seems such a farce, because the government wants the miner to have the mineral ground and yet blocks his efforts to get it.

In our case, after years of litigation and great expense, the government finally sold the land to us, the highest bidder, but in this case there was no agriculturist competitor.

Another case is that of two old prospectors in the Bisbee district who located what they thought was ground with great ore possibilities. They were holding this ground by annual assessment work. Years later an agriculturist filed a homestead covering their ground. Each year these men worked for wages in the large company mines, and after they had accumulated a small stake they spent it on what they thought was their ground. They toiled in this way until they had sunk a shaft over 300 ft. That hole in the ground is the greatest monument of the manual labor of two men that I have ever seen. They were old at that.

They were working against time, too, because the agriculturist had filed his claim as a homestead and the case was soon to be tried. The depth of 306 ft. was not enough to find pay ore, so they had a weak case when it came up for trial. The legal battle went on for years, and finally the old men lost everything.

Even though it was shown that the soil covering was thin, that to put in fence posts called for blasting the post holes, and that no water except the Bisbee city water at city prices was available, a crop had been planted on a small part of the ground and a feeble, sickly return was harvested after the summer rain, and this came nearer proving the ground to be agricultural than the miners had been able to prove it mineral. The prior rights of the miners were ignored. If a jury of twelve disinterested business men of Bisbee had been given a chance to examine the ground and been asked if it was their opinion that the ground had been filed on as a homestead for its agricultural possibilities or its mining possibilities, they would have unanimously agreed, I am sure, that the motive behind its acquisition was its mining possibilities. The reasoning would be simply: There are no profitable farms in the vicinity, but on the other hand in the immediate vicinity there are other homesteads obtained at the expense of other mine locators and later sold to the large mining companies. Woe be to the prospector who offers $5 per acre if there is an agriculturist who wants it at one-quarter of this price.

While in the act of writing this account of my difficulties in patenting ground, I have received a communication from the General Land Office at Washington which says:

"Mineral Survey 4065 contains an affidavit by M. J. Elsing, claimant's attorney in fact, under Circular No. 1128, relative to the mineral character of the claim applied for. This affidavit is wholly unsatisfactory, since it fails to state in detail the nature of the discovery upon which the location is based.

"The field notes of the mineral survey show that a maximum depth of the excavations made upon the claim is 20 ft. If claimant is unable to furnish a sufficient showing that there has been a discovery within the boundaries of the claim of a vein or lode of quartz or other rock in place carrying mineral, the entry must be canceled in spite of surrounding conditions and geological inference tending to show the land to be mineral in character."

Certain cases up in Idaho and Montana are cited and notification is given that thirty days are allowed "within which to furnish a sufficient showing as to the nature and occurrence of the alleged discovery." If not done, the entry will be canceled without further notice.

The ground above referred to is a small triangular piece entirely surrounded by patented ground. Its area is about five acres. It adjoins ground we already hold and fills up a little gap between two of our neighbors. Logically it should belong to one of the three surrounding companies. From a standpoint of good business the ground is worth absolutely nothing to anyone except one of these companies. If it were acquired by an outsider, it might be used as a club to force an unfair payment, but it could never become an independent mine operation.

The miner is not being treated fairly.

In *Engineering and Mining Journal* of June 9, 1928, appears an article by James D. Stewart, entitled "Is Agriculture to Continue to Restrict Hydraulic Mining in California?" Apparently here is another illustration of discrimination against the gold placer miner in favor of the farmer. The question has two sides, of course, but, after all, is it not true that you can dig potatoes almost anywhere in the United States, but you can dig gold nuggets in only a few places? If we do not need the gold, this is perhaps well; but if otherwise, all our government agencies should lend assistance in every way possible, and this should be possible without injustice to the farmer.

Up in the Verde valley, in Arizona, are two copper smelters. Farming there has never been very attractive, and it is because of other reasons than smelter smoke. The favorite crop there is the smelter smoke suit, and one occurs after another. It has become the policy of the companies to simply buy up these would-be farms if they can be purchased at any figure near their real value. It is another case like that of the gold and potatoes. We must have both copper and food, but copper is found only in limited areas and food is produced almost anywhere. If economic manufacturing in Pittsburgh necessitates a smoky city, the housewife has no legitimate right to complain if the washing gets covered with soot. Individual rights should always be subordinate to the rights of the many as represented by the country, the state, and the nation. The underlying principle should be the obtaining of the greatest benefits to the greatest number.

M. J. Elsing.

Tucson, Ariz.

Granby-Type Mine Car

To the Editor of "E.&M.J.":

In the mining literature during the last few years there have been frequent references to the Granby-type mine car by writers who in some cases were not familiar with the car. I am inclosing two photographs of the Granby 130-cu.ft.-capacity car, which may be of interest to some of your readers.

Dwight L. Sawyer.

Copper Mountain, B. C.

[The Granby-type mine car is self-dumping, thus avoiding the installation of a tipple. A four-wheel truck fitted with flexible couplings of the standard railway type and the three-sided car body made of sheet iron, reënforced with Z and L irons, are the two main parts of the car. The dumping mechanism consists of two chains, two cast-steel levers bolted to the ends of the car body, a roller and roller support riveted to the right side of the car, and a dumping block alongside the outer rail. The roller, ascending this track, raises one side of the car sufficiently to allow the contents to be discharged by gravity. Detaching of the door, opposite to the roller, is effected by the chain fastened to the short arm of the lever and to the truck. The second chain presses and locks the door when the car body is back at its normal position, as seen in the accompanying illustrations. Simplicity of design of both car and dumping mechanism will result in a low maintenance cost, as all minor repairs can be carried out by unskilled labor.—Editor.]

Bauxite Mining in British Guiana

To the Editor of "E.&M.J.":

On reading through the article on "Bauxite Mining in British Guina," issue of Aug. 31, I find that there has been a rather obvious but still rather troubling misprint in the second article. The average thickness of the Three Friends bauxite is shown as 18 in. This, obviously, should be 18 ft. Again, the lengths of the drills are shown in inches instead of feet. These drills are 12, 16, and 20 ft. long, respectively, and not inches, as shown. These two mistakes give an entirely wrong impression of our operations, as obviously it would never pay to mine bauxite only 18 in. in thickness.

Lawrence Litchfield, Jr.

Philadelphia, Pa.

Iron Contamination Effects in Cyaniding

To the Editor of "E.&M.J.":

As a matter of further interest in the discussion that has been aroused by Mr. E. M. Hamilton in his recent article in *E.&M.J.* relative to iron contamination in cyaniding, I would like to give the results of two tests recently made, and add a few comments.

For test purposes an oxidized silver ore was used. To be doubly sure that an exaggerated quantity of fine iron would be formed by the fine-grinding operation, 100 grams of fine iron filings was added to each kilogram of ore ground. Each test was ground for forty minutes, the only difference being that the first was ground in ordinary tap water, whereas the second was ground in tap water made strongly alkaline with lime. The grinding was done in an iron ball mill, 12x11 in., loaded with 38 lb. of small steel balls. The grinding period of 40 min. in each operation was four times that employed in grinding the ore to 70 per cent minus 200 mesh, thus grinding to a fineness beyond the realms of ordinary mesh testing. After grinding, both tests were agitated for 40 hours in the same strength cyanide solution made strongly alkaline with lime. The initial cyanide strength in each instance was 5.8 lb. NaCN per ton of solution.

In the test ground in tap water no cyanide remained after sixteen hours' agitation, and sufficient was added to bring it up to strength. The results of the two tests follow:

Granby-type mine car in action

	NaCN Consumed per Ton of Ore, Lb.	Assay of Residue, Grams Silver
Test No. 1	8.70	64
Test No. 2	1.44	.64

The consumption of 1.44 lb. per ton obtained on Test No. 2 is about normal for this ore. The 64-gram residue is a little lower than that obtained on this particular ore, because of the finer than ordinary grind.

On testing the solutions from both tests, No. 1 gave a strong showing of ferrocyanide. That from No. 2 gave none.

In explanation of the foregoing difference the following is offered: Take two iron balls fresh from a grinding operation and submerge one in a beaker of tap water and the other in a beaker of tap water made strongly alkaline with lime. In a short while a whitish cloud, probably of ferrous hydroxide, will be seen arising from the ball placed in tap water. On the one placed in lime water no action whatever will be seen taking place.

The ferrous hydroxide formed in the first beaker will of course consume cyanide and at the same time will tend to rob the solution of its oxygen by becoming oxidized to ferric hydroxide.

From this and the results of the foregoing tests the conclusion may be drawn that for cyanide to attack iron, no matter how finely divided it may be, it must first be changed to a ferrous compound. The solubility of pure iron in a cyanide solution will probably be found to be in exact proportion to the amount of ferrous hydroxide formed, which I believe will be very slight if the solution is kept strongly alkaline with lime, and therefore from this source no worry should be caused as to whether the ordinary ore for cyanide treatment should be ground in rubber- or in iron-lined mills.

I regret that, at this particular time, I do not happen to have a pyrite concentrate upon which to make similar tests as here outlined.

The probable result of the action of tap water on pyrites is the formation of ferrous sulphate, which is slowly changed to ferric sulphate by the action of the dissolved oxygen. In a solution strongly alkaline with lime, the action is probably that hydrogen slowly begins to form on the pyrites. This ionic hydrogen immediately acts to decompose the iron sulphide, with the formation of H_2S, which in the alkaline solution is instantly changed to CaS. In a solution containing only lime the CaS formed slowly oxidizes to CaS_2O_3 and $CaSO_4$. In a solution containing both lime and cyanide, sulphocyanides are formed. I believe that, in the treatment of clean pyrite concentrates that have not had a chance to become oxidized, very little iron will be found to go into solution by the action of cyanide, provided the solution is kept strongly alkaline.

As Mr. Hamilton plainly states that all his tests were made by grinding in water, and not in cyanide solution, the foregoing may in part explain the rather high cyanide consumptions obtained and also the differences between the tests ground in rubber-lined and iron-lined mills.

Mr. Denny, however, states that, in his comparative tests between the rubber-lined and iron-lined mills, the grinding was done in cyanide solution. The cyanide consumptions were much less than those of Mr. Hamilton, although tending to favor somewhat the rubber-lined mill. It may be that, on this particular ore, the pyrites ground on the iron surface became slightly coated with iron, forming an electrolytic couple, thereby increasing the consumption of cyanide in both operations, but decreasing the extraction in only one instance.

A great many tests were made several years ago by the Portland Gold Mining Company of Colorado, with the idea of forming that electrolytic couple by grinding the iron concentrates of the Cripple Creek district in a ball mill loaded with very small iron grinding media in a strongly alkaline cyanide solution, with the idea of bettering the extraction on these very refractory concentrates. The results tended to show a slight improvement, and in no instance was there a decrease in the extraction, and, as I remember, the cyanide consumption was never high. It is not my intention at this time to go further into the advisability of grinding iron concentrates in iron- or rubber-lined mills, but merely to point out that detrital iron in itself is probably not the source of cyanide consumption.

H. S. WILDMAN.
Parral, Chihuahua, Mexico.

Consultation

Refiners of Nickel and Copper Matte

"Can you give me a list of the refiners of nickel and copper matte in the United States that are not associated with the International Nickel Company?"

The International Nickel Company has a monopoly of the refining of nickel-copper matte in North America, its plant being located at Port Colborne, Ont. There are several electrolytic copper refineries, however, most of which produce a very small amount of nickel as a byproduct. These include: American Metal Company, Carteret, N. J.; American Smelting & Refining Company, Tacoma, Wash., Baltimore, Md., and Maurer, N. J. (the Maurer plant handling Phelps Dodge copper); the Anaconda Copper Mining Company, Great Falls, Mont., and Perth Amboy, N. J.; the Nichols Copper Company, Laurel Hill, New York City, and El Paso, Tex. (under construction); and Consolidated Mining & Smelting Company, Trail, B. C. Until recently, the United States Nickel Company maintained a small plant at New Brunswick, N. J., for the refining of nickel-bearing material from New Caledonia, but it has been reported that this plant has been closed and is for sale.

Tin Concentrates Wanted

"We would thank you to advise us where we can purchase tin concentrates. We are of course aware of the fact that practically none are produced in this country, so we would like to get in touch with the source of supply elsewhere or with some reliable broker in New York who has such connections."

We know of no broker or dealer in New York or elsewhere in the United States who deals in tin ore or concentrates. The domestic production is of no consequence; less than 100 tons is produced annually in Alaska, but no information is available as to the names of the companies shipping this material, or to whom it is shipped. One or two companies are endeavoring to make a success of tin mining in South Dakota, and might be able to supply a small quantity of tin-bearing material if you wish to secure some. These companies are: the National Tin Corporation, 1 Broadway, New York, and the Black Hills Tin Company, Tinton, S. D. Duncan Fox & Company, 42 Broadway, New York City, might arrange to supply you with imported material, even though it is not regularly dealt in.

Locating Small Masses of Metal Below the Surface

"What is the most effective electrical device developed to date for detecting the presence of small quantities of metal (a pound or so) about six feet beneath the ground or water?"

The representative of a well-known geophysical prospecting company says that he does not know of any device which will, with certainty, permit the discovery of small quantities of metal about six feet beneath the ground or under water. The location of such small quantities of metal would be expensive, and he believes there is no advantage in trying to attempt it.

The French army has been successful in finding old shells on the battlefields, he says. This, however, was an easy problem—a matter of locating large masses of iron, weighing 100 or 200 lb., under a cover of a couple of feet of soil. This was accomplished by means of dip-needle surveys. The purpose of these surveys was to remove shells which had not yet been exploded and to recover the iron.

Book Reviews

The World's Gold Production

SUMMARIZED DATA OF GOLD PRODUCTION. *By Robert H. Ridgway and staff of Common Metals Division, U. S. Bureau of Mines. Washington, D. C.: Government Printing Office. Price 20c.*

SINCE the discovery of America, world production of gold has approximated 1,003,500,000 oz. Scattered production of which there is no record would probably add no more than 1 per cent to this estimated total.

More than half the grand total of gold production for the last 435 years, or 516,273,000 oz., was produced in the first 27 years of the present century. Of the cumulative world production of gold since 1492, 467,000,000 oz. is estimated to exist in the form of monetary stocks, and 536,563,329 oz. represents the balance of gold lost or absorbed in uses other than monetary.

In spite of a superficial claim often made that gold does not pay its cost of production, it can hardly be doubted that United States gold production, amounting to more than $4,500,000,000 when reckoned roughly at $20 per ounce, must have been an important factor in assisting the development of other sources of national wealth. The British Empire production from the Transvaal (1901-27), of more than 198,000,000 oz.; from Australasia, of more than 168,000,000 oz.; from Canada, of nearly 32,000,000 oz.; from India and Rhodesia, together 32,000,000 oz.; and from other parts of the British Empire, of 12,000,000 oz.; amounting in all, since 1801, to 442,994,369 oz., or about $9,000,000,000, should be reckoned an important factor in the prosperity of that empire.

During the first half of the nineteenth century nearly three times as much gold was produced in the fifth decade as in the first; yet the production of the first decade of the next half century was almost four times that of the preceding decade and nearly twice that of the first half of the nineteenth century. A gradual decline is noted during this half century up to the last decade, which showed an increase of 94 per cent over the preceding decade. During the last half of the nineteenth century nine times as much gold was produced as during the first half. During the first decade of the twentieth century the average annual production increased over 8,000,000 oz., or 81 per cent, over the preceding decade's production. The second decade showed an increase in average annual production of over 2,000,000 oz., or 12 per cent, more than during the first decade.

In the world production of gold from 1493 to 1927, North America was the largest producing continent, contributing 281,056,639 oz., or 28 per cent, with Africa a close second, contributing 270,127,146 oz., or 27 per cent of the world total. Australasia produced nearly 169,000,000 oz., or 17 per cent; South America nearly 125,000,000 oz., or 12 per cent; Asia 112,000,000 oz., or 11 per cent; and Europe nearly 44,000,000 oz., or 4 per cent.

From 1493 to 1850, South America was the most important source of gold in the world, and during the eighteenth century 80 per cent of the production came from that continent. Africa was a close second during the fifteenth century, but soon lost its importance. North America, Europe, and Asia showed definite increases in the first half of the nineteenth century. However, in the last half of the nineteenth century South America became less important, North America and Australasia assuming, respectively, the lead with 36 per cent and 31 per cent of the world's production. Both Asia and Africa also produced more in this period than did South America. In the first quarter of the twentieth century Africa became the leading producer, as 42 per cent of the world production came from mines in that continent. North America, with 29 per cent, was second; and Autralasia, with 13 per cent, was third. Asia, South America, and Europe followed in order. In the period 1926-27 the relative position of the continents is the same, except that Australasia fell from the third to the fourth place as its production declined to 3 per cent. Africa led by a greater margin than before, whereas North America's share of the world total showed a substantial decline.

Considering the production of individual countries from 1493 to 1927, the Transvaal has been the largest contributor, producing nearly 219,000,000 oz., or 22 per cent of the world figure. This great total was attained in 43 years, as the Transvaal deposits were discovered in 1885. The United States has produced almost as much as the Transvaal, contributing nearly 214,000,000 oz., or 21 per cent of the world total. Production in the United States did not become important until 1848. Australia and New Zealand together produced 17 per cent, Russia 9 per cent, Colombia 5 per cent, and Canada and Mexico 3 per cent each.

From 1493 to 1800 Colombia produced more gold than any other country, or about 27 per cent of the world total for that period. Brazil was second, with 24 per cent.

During the first half of the nineteenth century Russia was the largest contributor, with 28 per cent; the United States ranked second, with 16 per cent; Colombia third, with 15 per cent; and Brazil fourth, with 11 per cent.

In the second half of the nineteenth century the United States and Australia assumed the lead, with 33 and 27 per cent, respectively. In fact, during the 25 years 1850 to 1875, inclusive, these two produced almost as much gold as had been produced in the entire world from 1493 to 1800.

During the first quarter of the twentieth century the Union of South Africa (Transvaal) produced 37 per cent of the world output, replacing the United States as the leading world producer. Notwithstanding the fact that the average annual production had increased 50 per cent, the share of the United States in world production declined to 20 per cent. Australia produced 11 per cent, Russia 5 per cent, Canada and Mexico 4 per cent each, and Rhodesia 3 per cent. In 1927 the seven leading producers were the Union of South Africa (52 per cent), the United States (11 per cent), Canada (10 per cent), Russia (5 per cent), Mexico (4 per cent), Rhodesia (3 per cent), and Australia (3 per cent).

The date of the first discovery of gold in the territory which now comprises the United States is not known, but the existence of gold in the southern Appalachian states was discovered by the Spaniards in the early part of the sixteenth century. A small production from North and South Carolina antedates the Revolutionary War. Gold was found in Virginia as early as 1782, but until 1829 production was insignificant. In 1829 gold was discovered in Georgia, which soon became one of the leading producers of the country.

The production of gold in the United States before 1848 was insignificant, as the total production up to that time was less than 1,200,000 oz. In the decade 1831-40 the average annual production was only 31,800 oz., 5 per cent of the world total. Immediately after the discovery of gold in California, in 1848, production increased so rapidly that in 1849 the United States became the leading world producer. By 1853 the production had exceeded 3,144,000 oz. In six years the production had been multiplied 73 times. During the period 1851-55 the United States produced nearly 45 per cent of the world total. At this time the production of the Western states completely dwarfed the output of the Appalachian district, the production of which since 1848 has been relatively unimportant.

After 1853 the production declined steadily until 1862, owing to the Civil War and the exhaustion of the known, easily worked, richer placer deposits in the West. Gold production of Australia surpassed that of the United States from 1855 to 1863. The increase noted up to 1866 was due largely to discoveries in Nevada and Montana, but following this

there was a recession to 1,619,000 oz. in 1875. At about this time the production of the Comstock lode was rapidly increasing and contributed a large part of the increase in United States production from 1873 to 1878. Thereafter, production again declined to 1,451,000 oz. in 1883, the lowest since 1848. During the five-year period 1881-85 the United States produced 31 per cent of the world's gold supply.

From 1892 to 1900 there was a remarkable increase in production, which almost equaled the rise occasioned by the discovery of gold in California in 1848. During this period yearly production increased 140 per cent; it amounted to 3,830,000 oz. in 1900, owing largely to the discovery of the famous Cripple Creek deposits of Colorado and the introduction of the cyanide process. Notwithstanding this rapid increase, the production of Transvaal surpassed that of the United States in 1898 and 1899, but fell below it again in 1900 to 1904 as a result of the Boer War.

There was a general but somewhat irregular increase in production in the United States from 1900 to 1915, as the deposits of Alaska, Goldfield, and Tonopah were developed. The peak production of the United States was made in 1915, when 4,823,672 oz. of gold was produced; but maximum five-year period production was from 1906 to 1910, when yearly production averaged nearly 4,600,000 oz.—22 per cent of the world total.

As a result of inflation during and immediately after the World War, resulting in a decline in the relative value of gold, production dropped 50 per cent for the period 1915-20. Since 1920, there has been a tendency to further decreases in production, although it is not as marked as in the preceding period. From 1921 to 1925 the average annual output was 2,369,000 oz., 14 per cent of the world total, as compared with an average of 4,557,000 oz. in the period 1911-15. The 1927 output was 2,117,000 oz., which was 11 per cent of the world total.

Since 1905 the United States has been the second largest producer of gold in the world, but if present trends continue the production of Canada may soon surpass that of the United States. In 1927, the output of the Transvaal, the largest contributor, was nearly five times as much as the production of the United States. Canada's production was in that year about 85 per cent of the United States output.

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METALLIZATION FROM BASIC MAGMAS. *By Carlton D. Hulin. Berkeley, Calif.: University of California Press. Pp. 233-274. Price 65c.*

The author gives a short reveiw of the present trend of theory of ore genesis. He discusses magmatic differentiation and points out the fact that experience has shown the preference of certain elements for the acid differentiate and of certain others for the basic differentiate. Following a list of the elements, showing their preferences, several pages are devoted to the association of basic intrusive igneous rocks and ore deposition.

Dr. Hulin gives a table of important mining districts, showing the mineralization, the intrusives, and the sequence of these for each district.

The theory is offered, with supporting evidence, that ore deposits are the result of deposition from two sets of solutions, and the conclusion is reached that mining districts show both acid and basic rocks associated with "ore deposits of the types formed by hydrothermal, pyrometasomatic and emanation agencies . . . The general sequence of events is (1) intrusion of the acid group; (2) intrusion of the basic group; and (3) ore deposition."

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STRONTIUM FROM A DOMESTIC STANDPOINT. *By R. M. Santmyers. Bureau of Mines Economic Paper No. 4. U. S. Government Printing Office, Washington, D. C. Pp. 19. Price 15c.*

THIS is the fourth of the series of papers which began with a treatise on copper. The author presents the economic aspects of the strontium industry in the principal producing countries—England, Germany, Canada, Sicily, and the United States. Over four and a quarter million pounds of strontium minerals (from England) and salts (from Germany), valued at almost a quarter of a million dollars, were imported into the United States in 1927. Strontium is used in making beet sugar by the Scheibler process, in the manufacture of fireworks, and, when alloyed with copper, in making castings, which are thereby hardened and freed from blow holes. Ground celestite, the sulphate, has also been used as a substitute for barite as a filler and for various other industrial purposes.

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DISRUPTED STRATA. *By M. H. Haddock. London: Crosby Lockwood & Son. Pp. 104. Price 16s.*

THE author has presented in this small volume a sketch of the accumulated knowledge of several of the men best grounded in fault studies. To this material Mr. Haddock has added his own observations and has arranged the whole so as to make it presentable and understandable to those who will use it most—the geologist and the mining engineer.

The pages devoted to definitions and primary considerations give a thorough discussion of the chief types of faults. Various problems brought about as a result of faulting are listed in succeeding chapters. These are discussed, and solved by the use of trigonometry. Numerous figures and plates showing three-dimensional drawings aid greatly in following what at times become rather involved equations.

This book represents a considerable body of facts and formulas bearing directly on the solution of structure and fault problems as related to other planes, such as stratified rocks, veins, and other faults. In the use, however, of this material one must ever remember that though faults over a given area may be uniform in dip and strike, they also may, and commonly do, change markedly in these respects.

DONALD M. FRASER.

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GEOLOGY OF THE SHABANI MINERAL BELT, BELINGWE DISTRICT, SOUTHERN RHODESIA. *By F. E. Keep. Salisbury, Southern Rhodesia: Geological Survey. Pp. 193, with maps and other illustrations.*

THIS paper gives the general geology of the district, a detailed discussion of both the asbestos and the gold bearing rocks, and a description of the different lodes, claims, and mines.

That part of the work dealing with the asbestos area is of special interest. The author here reviews previous work and theories on the origin of asbestos. In his own studies he came, independently, to the conclusion reached by others, that the serpentinization of ultrabasic rocks is the result of action of magmatic waters. At Shabani the altered rock was dunite and the magmatic waters are thought to have accompanied the intrusion of the granite batholith of the Lundi Native Reserve. Mr. Keep also discusses the origin of chrysotile asbestos, talc-carbonate rocks, actinolite rock, and brittle-fibre and slip-fibre asbestos.

A geologic map and cross-sections of the district accompany the paper.

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INVESTIGATIONS IN ORE DRESSING AND METALLURGY. *Publication No. 695, Mines Branch, Department of Mines, Ottawa, Canada. Pp. 186.*

MUCH to interest the metallurgist will be found in this bulletin, particularly with respect to flotation. The volume includes reports of investigations made in the department's ore-dressing, metallurgical, non-metallic, chemical, and hydrometallurgical laboratories. A paper on "Custom Concentrators" is contributed by C. S. Parsons and A. K. Anderson; one on the "Concentration of Ores of Western Quebec," by J. S. Godard; and a third on the "Treatment of Mixed (bulk) Concentrates From the Base-metal Sulphide Ores," by W. E. Harris. Other contributors are R. K. Carnochan, R. A. Rogers, R. J. Traill, W. R. McClelland, J. D. Johnston, and H. C. Mabee.

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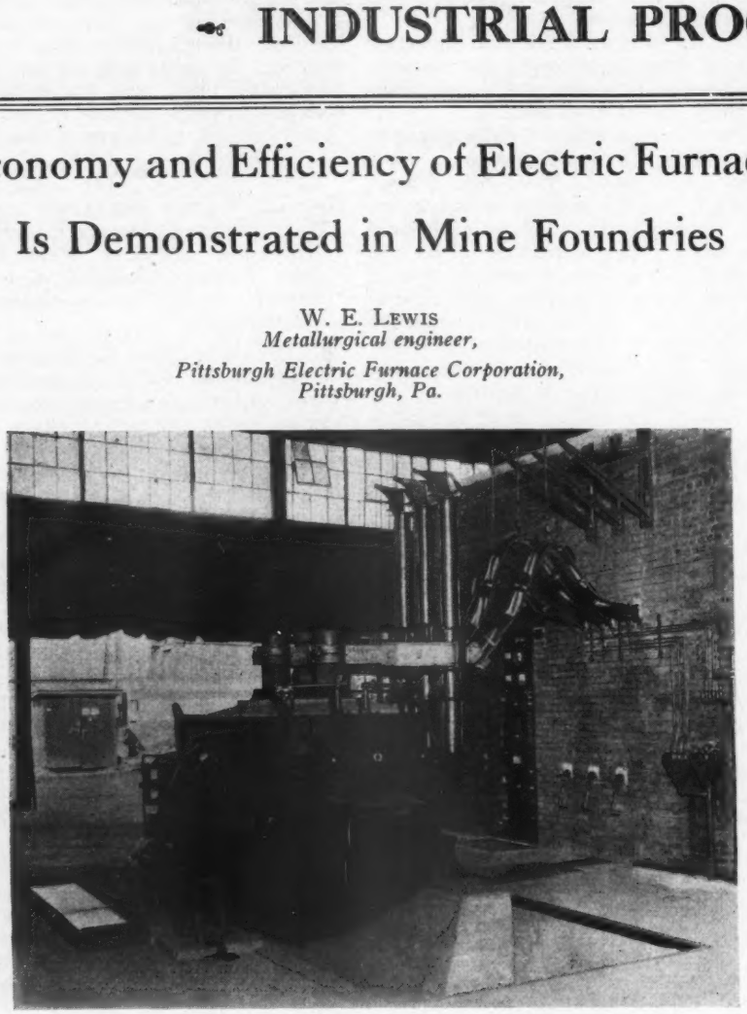
CHEMISTS' POCKET MANUAL. *By R. K. Meade. Easton, Pa.: Chemical Publishing Company. Price $5.*

This is the fourth edition of one of the most useful and reliable handbooks published, containing tables, formulas, calculations, and data on physical and analytical methods for the use of the chemist, chemical engineer, metallurgist, and student.

Economy and Efficiency of Electric Furnace Is Demonstrated in Mine Foundries

W. E. Lewis
Metallurgical engineer,
Pittsburgh Electric Furnace Corporation,
Pittsburgh, Pa.



Typical 'Lectromelt furnace plant for mine foundry, with a capacity of 1½ tons per hour

SEVERAL large mine foundries in the Western United States, in South America, and in Mexico have found the electric furnace ideal for the production of repair parts. These furnaces are used for making castings of carbon and alloy-steel, manganese steel and gray-iron, and also abrasion-resisting grinding balls and ball-mill liners of hard white iron. Several foundries are producing large quantities of grinding balls on the ground, utilizing steel scrap that would otherwise be wasted.

The furnace described and illustrated herewith is particularly applicable for this purpose, being of simple design and reliable in operation. Its heat source consists of three triangularly spaced arcs. The current is applied at a considerably higher voltage or pressure across the arcs when melting down cold steel scrap than when carrying on the after-molten procedure of refining and superheating.

As will be noted from the accompanying illustration, the furnace, consisting of a stout cylindrical steel furnace shell lined with refractory shapes, is arranged to tilt forward a full 45 deg., so as thoroughly to drain the hearth. It tilts backward nearly as far for slagging. The charging door is placed diametrically opposite to the pouring spout. The charge is shoveled in by hand, if one of the smaller sizes is being used, or delivered by means of special charging chutes, provided the usual operating size of furnace of 2 tons or larger is used.

A typical heat cycle for the production of an ordinary heat of plain carbon acid foundry steel for castings, say of an analysis of about 0.25 carbon, 0.70 manganese, 0.30 silicon and low phosphorus and sulphur, would be about as follows:

The steel scrap, consisting of about one-third steel turnings, one-third miscellaneous steel scrap and one-third foundry returns, would be charged, and the main switch closed at the switchboard connecting the main transformer with the three-phase high-tension supply lines, from which the power for operating the equipment is secured. Then the furnace would be on what is usually known as the high tap, or high-melting voltage. The electrodes are then lowered by the automatic regulator to make contact with the scrap, to draw and maintain suitable arcs. These arcs are grouped closely at the center of the furnace, to give good refractory life. Usually, 350 heats per roof and side wall are obtained under the conditions outlined.

After the steel has been melted the main breaker is thrown out and the transformer-coil connections or taps are changed to give a reduced power input and arc pressure during the refining and superheating period. The melter soon becomes able, by properly manipulating his slag, to bring the metal to a properly deoxidized condition, suitable for the addition of ferrosilicon and ferromanganese.

The furnace described, known as the 'Lectromelt, is supplied with a special multi-voltage transformer of unusually stout and especially braced construction, to withstand the hard usage to which it is subjected in foundry or steel-mill work. These transformers are, of course, suitably protected by means of special adjustable high-tension reactors, which limit the current properly. The automatic regulation is performed by individual winches and winch motors, and each phase electrode arm and electrode is suitably counterbalanced, so that the winch motors have only a minimum amount of work to perform in accomplishing rapid and accurate regulation.

Power input is controlled by varying the arc length. The arc, of course, forms almost the entire resistance of each secondary phase, so that, by altering the position of the electrodes slightly, the wattage delivered at the arc per phase may be closely controlled.

The plow-steel regulating cables pass

FINE-GRINDING *trend necessitates adequate supply of grinding balls and mill liners, cheaply made on the property by means of an electric furnace, which is also available for general foundry work in the melting and refining of iron and steel and the production of other types of renewal castings.*

from the electrode arms over sheaves at the top of the three columns and down through the columns to a system of compensating sheaves to prevent them from binding when the furnace is tilted either forward or backward. From these compensating sheaves the winch cables are carried to the winch motors, which in turn are actuated by three automatic regulator elements. The control is both by means of the amperage or current per phase, and by the voltage impressed by transformer low-side windings.

The following cost figures show the use of a one-ton operating charge 'Lectromelt furnace making cast iron of an analysis approximately 3.25 per cent carbon, 0.55 manganese, 0.55 phosphorus, 2.75 silicon, and 0.05 per cent sulphur:

The figures in the table list the operating costs for a three-month period, making white-iron grinding balls in a 1½ ton per hour 'Lectromelt furnace:

	Cost per Ton
Furnace labor (cutting scrap, charging and operating)	$1.83
Power—550 kw.-hr. @ 0.8c.	4.40
Electrodes, freight added, 15 lb. per ton @ 11c. (carbon)	1.65
Refractory maintenance	.20
Miscellaneous repairs and furnace tools	.10
Steel scrap	20.00
Ferro-alloys and slag additions, and recarburizer	2.09
Total cost of molten metal in the ladle	$30.27
Chill mold and pouring labor	2.25
Chill and ladle maintenance	.04
Water	.10
Total shop cost	$32.66
Recovery of good balls, 75 per cent with a 15 per cent scrap return, making the total manufacturing cost: $\frac{32.66}{0.75} - (0.15 \times 20) = \$43.53 - \$3$	40.53

Annual fixed charges:				
Depreciation (first cost plus installation expense) $19,000 ÷ 10 years				$1,900
(a) Average interest at 6 per cent: (11 ÷ 10) x $19,000 x (0.06 ÷ 2)				627
Allowance for mechanical repairs				350
Total annual fixed expense				$2,877
Monthly furnace operating costs, June, 1926:				Per Ton of Good Castings
Monthly fixed expense:				
$2,877 ÷ 12 months			$239.75	$1.79
Materials charged:				
Pig, 31.2 tons at $26.28		$819.94		
(b) Cast-iron scrap, 93.7 tons total, less 58.281 tons foundry returns, or 35,419 tons at $18		637.54		
Cast-iron borings, 31.2 tons @ $9		280.80		
Steel turnings, 26.975 tons @ $9		242.78		
Laminated punchings, 24.925 tons @ $9		224.33	2,205.39	16.46
Ferrosilicon, 5,917 lb. @ $0.0425		251.46		
Ferromanganese, 279 lb. @ $0.07		19.53		
Anthracite coal, 112 lb. @ $0.00675		.76		
Carbon, 10,418 lb. @ $0.0109		113.56	385.31	2.88
Electrodes, 688 lb. graphite @ $0.2125			146.20	1.09
Refractories @ $0.2525 per ton of material charged			54.63	.41
Power:				
Consumption, 125,280 kw.-hr. @ $0.00822		$1,029.80		
Demand charge, 468 kva. @ $1.25		585.00	1,614.80	12.05
Labor on furnace:				
Melter, 8 hours @ 65c.	$5.20			
Helper, 8 hours @ 50c.	4.00	9.20		
70 tricks @ $9.20			644.00	4.81
Total cost per ton of good castings, including fixed charges			$5,290.08	$39.49

(a) Allowing for interest earned by depreciation reserve.

(b) Includes 54.146 tons of gates and sprues, and 45.135 tons of defective castings.

Diameter of Rod and Ball Mills Shows Tendency to Increase

AT THE Ajo property of the Calumet & Arizona company, Marcy rod mills have been lengthened to 15 ft. The mills are 6 ft. inside diameter. At the Hollinger the mills are 6 ft. 6 in. inside diameter and use rods 14½ ft. long. At a recent installation for pulp and paper work, Marcy mills 7 ft. inside diameter, and each provided with 50 tons of 16-ft. rods, were installed. A tendency to use mills of larger diameter and longer rods is visible. A similar tendency to increase diameter is manifest in the ball mills. The present trend in both types of mills is thus toward larger diameters, and this may mean fewer units for a given tonnage as well as somewhat greater power efficiency. Lengthening the rods in the rod mill is said to give better operating conditions, as the longer the rod is, the straighter it will roll.

Marcy rod mills of larger diameter, are driven by a central gear at 15 r.p.m. with two gear reductions. The mill is supported on tires and rollers which are equipped with S.K.F. type roller bearings. The construction thus represents the drift toward simplicity and better mechanical design. How far the increase in the diameter of ball and rod mills will go remains to be seen. In the Miami plant Williamson ball mills of an inside diameter of 10½ ft. have been installed. The diameter of the largest Hardinge conical mills is 10 ft. and that of the largest Marcy ball mill is 9 ft. 2 in. inside. Ball mills have advanced to greater inside diameters much more rapidly than have the rod mills.

Whether the latter type will be manufactured in units of similar diameter is problematical, but apparently no special reason exists why they should not be. Obviously, the total capacity of the grinding plant is an important factor in selecting the size of individual units.

The Equipment Review

SIGNIFICANT is the news that Carels Frères, of Ghent, have recently completed building their first Diesel engine under license from the Worthington Pump & Machinery Corporation. This engine, a 4-cylinder, 2-cycle, double-acting unit developing 4,000 b.hp. at 128 r.p.m., has cylinders 28 in. in diameter and a 10-in. stroke. It is similar to those furnished by Worthington to the Shipping Board and is to drive a large alternator in South America. Carels Frères were among the pioneer builders of Diesel engines, and many excellent designs have come from their shops.

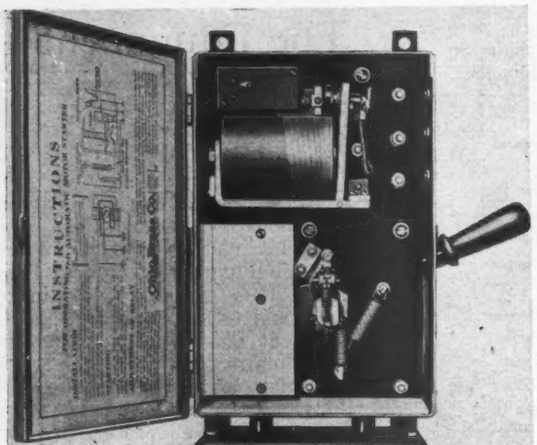
A New Compressor

A two-stage air compressor of the vertical-tandem type is soon to be introduced by the Gardner-Denver Company, Denver. It will weigh only 350 lb. and will produce a continuous flow of 24 cu.ft. of air per minute at pressures up to 500 lb. It is of simple construction, the low-pressure head, high-pressure cylinder and intercooler being combined in a single casting. Main bearings are of the Hyatt roller type. Lubrication is effcted by a combination oil pump and splash system. This compressor can be furnished with a pulley for "V" belt drive or for direct connection to electric motor or other source of power.

Some New Motor Starters Introduced

Several motor starters have recently been introduced. Outstanding among them is a line of automatic devices developed after long research by the Ohio Brass Company. The latter, in addition to simple and sturdy construction, have an added economic and protective advantage in combining with the starting unit a circuit breaker for overload protection. The cycle of operation is simple. It is as follows:

The circuit breaker switch, or a line knife switch, if this be employed for operating the circuit, is closed, thus connecting the motor to the line through the starting resistance. Essentially, the operating mechanism consists of a magnetic coil and armature. The coil is connected in series with the motor shunt field and is short-circuited by a contact made between two bi-metallic elements. As the field current heats the latter, the contacts open. The operating coil is thus inserted in the circuit, pulls up the armature to short-circuit the starting resistance, and connects the motor to the line. When the motor attains full running speed the starting resistance and bi-metal contacts of the thermal breaker are automatically shunted out of the circuit. Resistance and thermal breaker then cool, and are ready for the next starting operation. The time interval for starting is readily adjustable by means of a screw on the thermal ele-



A new automatic motor starter

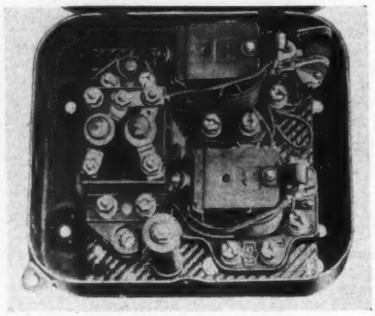
ment by which the pressure on the bimetallic contacts may be varied.

Connections are so made that during starting only one-third of the windings of the circuit breaker overload coil are in the starting circuit. Thus, the inrush of current needed to start the motor without tripping the circuit breaker is permitted. Without such a scheme the overload device would be useless as an element of protection to the motor once it had attained its normal running speed. The setting of the breaker would necessarily be so high to accommodate the in-rush of starting current, that this high setting would be ineffective in protecting the motor against continuous running overloads. Once the starter has completed the starting cycle, the complete overload coil is inserted in the circuit and effective protection against overloads is afforded.

A low voltage release is also provided. This at the failure of power automatically releases the starter to return to the starting position; and when power returns the starter automatically brings the motor up to full running speed and cuts it in on the line. No personal attention is required to start the motor again unless the circuit breaker opens.

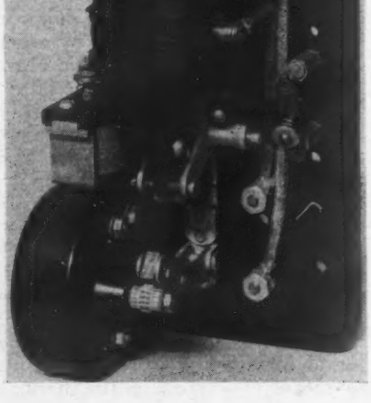
These starters will carry out the starting cycle even though the voltage is only one-third of normal. They will hold in running position, although the line voltage drops to one-fourth of normal. In other words, 250-volt starters will start on as low as 85 volts and hold in as low as 65. In the varied and often extreme conditions of fluctuations of voltage encountered in mine service, these features are valuable in reducing the attention required for motor starters.

The new starters are intended for use with shunt- and compound-wound motors. They are furnished for standard motors from 2 to 15 hp., rated at 250 and 600 volts. They may also be had, it is stated, with the same degree of reliability for use with motors under and above the figures given.



A starter with overload relay for (d.c motors see above at right)

Field relay for new starter for synchronous motors



General Electric has re-designed its three lines of synchronous motor starters — namely, the semi-magnetic reduced-voltage type, the magnetic reduced-voltage type, and the magnetic full-voltage type. These are now equipped with the new rectangular type of meter with non-glare glass and a new type of field-actuating relay.

Operation of the new field-actuating relay which controls the field contactor is dependent upon the speed of the motor, and, in addition, a definite time delay after the motor reaches approximately 95 per cent speed. When full voltage is applied, the immediate closing of the relay contact is provided by a lock-out coil which holds the relay contact arm motionless until the motor accelerates to approximately 95 per cent of synchronous speed, when the voltage across the resistor decreases and allows the lockout coil to release the timing mechanism. After the predetermined time the relay contacts close, energizing the field contactor and applying field to the synchronous motor. Closing of the relay contacts may be delayed for several seconds after the lock-out coil releases the timing mechanism. This time delay insures that the motor will accelerate its load to the maximum possible speed before the field voltage is applied.

Two other starters have been introduced by Cutler-Hammer, Inc., Milwaukee. One of these is an automatic across-the-line starter for general applications of d.-c. motors up to 2 hp., 115 or 230 volts. Among the features of the new design are small size, low cost, double line break, thermal overload protection, low voltage protection, silver contacts, and completely inclosed structure. The other is a counter e.m.f. type, automatic starter for small d.-c. motors for general applications. Among its features are: small size, reduced-voltage starting, thermal overload protection, low voltage protection, and renewable silver contacts. It is also rated up to 2 hp., 115 or 230 volts.

BULLETINS

METERS—The Connersville Blower Company, Connersville, Ind. Bulletin No. 4-D, on the operating principles of meters.

INSTRUMENTS—Leeds & Northrup Company, 4901 Stenton Ave., Philadelphia, Pa. Notebook No. 4 on the Kelvin Bridge.

ELECTRIC FURNACES—General Electric Company, Schenectady, N. Y. Bulletin No. GEA-1146.

WELDING—Alloy Welding Processes, Ltd., Ferry Lane Works, Forest Road, Walthamstow, London, E.17, England. Bulletin No. 61: conclusive welding tests.

HAULAGE — Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa. Special Pub. No. 1841, May, 1929, describing Baldwin-Westinghouse mine and industrial locomotives.

SWITCHES—General Electric Company, Schenectady, N. Y. Bulletin No. GEA-181B. Describes CR 7006-D7 and -D9 a.-c. inclosed magnetic switches for alternating-current motors.

DIAMOND DRILL—Sullivan Machinery Company, 400 North Michigan Ave., Chicago, Ill. Bulletin No. 85-I. Describes "Bravo" hand-power type diamond core drill.

WATER WHEELS—The James Leffel & Company, Springfield, Ohio. Bulletin No. W206. Describes the modern installation at the Buffalo, Niagara & Eastern Power Corporation's hydro-electric plant at Middleport, N. Y.

SPEED REDUCERS—Westinghouse Electric & Manufacturing Company, Nuttall Works, Pittsburgh, Pa. Circular No. 1856, describes bedplates with or without outboard bearings for type SVR and DVR speed reducers.

VACUUM PUMPS — The Connersville Blower Company, Connersville, Ind. Bulletin No. 20B. Describes cycloidal vacuum pumps (with two-lobed impellers) for suction rolls, flat boxes, driers, felt conditioners, or other paper mill service; also process requiring normal vacuums up to 15 in. with a maximum of 20 in. mercury.

Personal Notes

Charles Spearman has returned to Montreal, Canada, after examining mining properties in California.

Major **P. S. Inskip,** O.B.E., has resigned from the board of directors of the British South Africa Company.

B. B. Thayer, vice-president of the Anaconda Copper Mining Company, returned to New York City on Nov. 18, from a trip through the West.

A. W. Bean, general manager of Benguet Consolidated Mining, has returned to San Francisco from the company's property at Benguet, Philippine Islands.

D. C. McKechnie, mining engineer, with the Consolidated Mining & Smelting Company, has been making examinations in the Alice Arm district of British Columbia.

E. A. Barnard, metallurgist with Anaconda Copper Mining Company, at Anaconda, Mont., delivered a lecture on the Cottrell process at the Montana School of Mines, on Nov. 5.

H. Foster Bain, secretary of the A.I.M.E., was the guest of honor at a dinner given on Nov. 22, at Tucson, Ariz., by the University of Arizona and engineers living in Tucson.

A. G. Mackenzie, secretary of the Utah chapter of the American Mining Congress, returned to Salt Lake City recently, after a three weeks' trip to New York and Washington, D. C.

Thomas M. Fagan, an attorney, of Lusk, Wyo., delivered an address on "The Past, Present, and Future of Metal Mining in Wyoming," before the third annual Wyoming Mining Congress, held at Sheridan on Nov. 15.

L. A. Levensaler and **B. B. Neiding** wish to call attention to the fact that they are not affiliated in any way with the Consolidated Copper Company that has an option on the Blue Ledge mine near Medford, Ore.

Howard D. Smith, president of the Consolidated Coppermines Corporation, was a recent visitor in San Francisco from Carson City, Nev., where his company is defendant in a suit instituted by the Nevada Consolidated Copper Company.

S. B. Hobart is in charge of operations for the Troy Mines Company, which recently succeeded to all holdings of the Greenough Investment Company, of Spokane. These are all in the Troy district of Montana, and include the Snowstorm and Morning mines.

H. W. Wilson has been appointed mine superintendent for the Metaline Mining & Leasing Company, operating in the Pend Oreille district of Washington. **W. G. Norris,** of Vancouver, B. C., consulting engineer and managing director of the company, recently visited the mine.

J. H. W. Kerston, newly appointed representative for *Engineering and Mining World,* sailed from New York, on Nov. 15, on the "Bremen." His territory will cover all of northern Europe, with headquarters at Berlin. Mr. Kerston was educated in Germany and England, and has lived in the United States for the last fifteen years.

John B. Huttl left New York City recently for Salt Lake City, to become editorial representative there of *Engineering and Mining Journal.* Mr. Huttl

JOHN B. HUTTL

was educated in England and Germany, where he was graduated from the M.A.N. Technical School at Nurnberg. After experience in Germany, he joined the staff of the Sociedad Minera y Metallurgica de Peñarroya, at Puertallano, Spain. Later he was with the Mexican Mines of El Oro, at El Oro, Mexico. He recently completed a contract with the New York & Honduras Rosario Mining Company, after which he took a vacation and observation tour through England and continental Europe. Mr. Huttl will cover the Southwestern as well as the Mid-Western states.

L. V. Bell and Dr. **I. W. Jones,** each in charge of a party of the geological survey now being made of Quebec, were in Montreal for a few days last week. Mr. Bell has spent the season in the Malartic and Cadillac districts of northern Quebec. Dr. Jones has been in the lead and zinc districts of the Gaspé peninsula for the last five months.

John McLeish, director of the Mines Branch of the Canadian Department of Mines, has returned to Ottawa, Ont., following conferences with the authorities of the western provinces regarding co-operative investigational work. While in the West Mr. McLeish attended the meeting of the Canadian Institute of Mining and Metallurgy at Edmonton, Alberta.

Stanly A. Easton, in a talk to the student body of the Idaho School of Mines, at Moscow, Idaho, on Nov. 8, stressed the value of a broad education—one well grounded in the fundamentals of mathematics, chemistry, and physics. The mining graduate, he held, should be so broadly trained that he can achieve a reasonable degree of success in almost any phase of engineering.

M. F. Coolbaugh, president of the Colorado School of Mines, is chairman of a committee of mining men recently appointed by W. F. Denious, president of the Colorado Association. This committee will provide the material necessary to the inclusion of mining, with its proportional importance as a Colorado industry, in the forthcoming advertising matter to be put out by the association.

Clarence H. Mackay has made a gift of the Walther library to the Mackay School of Mines, at Reno, Nev. The library, collected by Dr. **Johannes Walther,** of Halle, Germany, contains between six and seven thousand papers published within the last sixty years, including those of the last year or two. As it is especially rich in papers dealing with the problems of semi-arid regions, it will be a great aid in the study of conditions in Nevada. The library has just arrived at Reno, Nev., and the work of cataloging is being done so that it can be made available at the earliest possible date.

F. A. Wardlaw, Jr., of Salt Lake City, has been appointed general superintendent of the Inspiration Consolidated Copper Company, at Inspiration, Ariz., and **Harold Aldrich,** superintendent of the leaching plant, has been appointed assistant general superintendent. Mr. Wardlaw has for the last two years been general superintendent of the International Smelting Company's mining operations in Utah and California, which include properties at Park City, Bingham, and Tintic, Utah, and the Walker mine in California. Mr. Aldrich has been with Inspiration since 1918.

OBITUARY

John McClintock, formerly Illinois State Mining Inspector, died at his home in East St. Louis, Ill. on Nov. 13. Mr. McClintock was 68 years of age.

John J. McDougall died at Sydney, N. S., on Nov. 14. He was general mine superintendent for the British Empire Steel Corporation, having risen to that position from a start with the company as mine surveyor. Mr. McDougall was 42 years of age.

Russell E. Popham, president of Amulet Mines, Ltd., of Quebec, died on Nov. 9, after a six months' illness. Three years ago he retired from the firm of Popham & Company, which he formed after his return from overseas service during the war. Mr. Popham, who was 43 years old, was a director of several mining companies.

NEWS OF THE WEEK

Summary

DESPITE the temporary decrease in production that will result from the Dome fire, the Porcupine district of Ontario is expected to stabilize its production at over $20,000,000 annually, as the situation at Hollinger has improved considerably. Page 828.

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Rehabilitation of the Southwest Metals smelter at Humboldt, Ariz., controlled by Sheldon Mining, will be completed early in 1930. The chief supply of ore and concentrate will come from the Sheldon and Southwest companies' mines. Page 827.

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At the regular monthly meeting of the Utah section of the A.I.M.E., three important addresses on shaft sinking, mine pumping, and practice at Utah Copper were made. Summaries of the speeches may be found on page 830.

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Nevada Consolidated has completed construction of an 8½-mill copper pipe line, connecting the McGill concentrator with the company's water supply at Duck Creek, Nev. Page 831.

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Examination of the Jervois Range discoveries, in Central Australia, by mining engineers and geologists indicates that the potentialities of that field were exaggerated in early reports. Page 826.

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Initiation of a regular direct passenger service from New York to Cape Town will facilitate travel to and from the Empire Mining Congress as well as shorten the time necessary to reach the Rand and Rhodesia. Page 825.

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American Smelting & Refining has acquired control of the Yankee, Bellorophan, and Silver Wave properties, in the American Fork district, Utah, as part of its program of exploration in that state. Page 830.

Bureau of Mines Trained 81,000 Miners in Safety Work in 1929

PAUL WOOTON
Special Washington Correspondent

TRAINING of 81,000 workers in coal and metal mines in first-aid and mine rescue methods and the pushing of its campaign for the use of rock dust as an explosion preventive are among the accomplishments of the last fiscal year cited by the director of the U. S. Bureau of Mines in the annual report he will submit to Congress on Dec. 2.

Other accomplishments stressed in the annual report include the results of the co-operative work with the Safety in Mines Research Board of Great Britain; health and sanitation work in metal mines; publication of cost and other data concerning representative operations in connection with metal mining; development of information concerning geophysical prospecting and mine ventilation; improvement in methods of recovering more of the mineral content of ores; new data pertaining to the mining and recovery of quicksilver; development of fundamental data on the smelting or iron ores and on steel making; important progress toward the profitable recovery of manganese from low-grade ores; steps toward more efficient production of non-metallic minerals; additional drilling for commercial potash; assistance in the development of methods for the recovery of more oil from sands; and production of helium at the lowest cost ever attained.

Commenting on the studies of mining and milling methods, the report says:

"The methods of milling at important characteristic plants will be studied, and analyses will be made of the cost of treating ore under different conditions. The final objective is to give the mine operator, the mill superintendent, the consulting engineer, and the mining professor and student, a series of papers from each mining district on present mining and milling practice and cost. Eventually, bulletins on each method of mining and milling, giving details of its application in the different districts, will be issued, provided adequate printing funds can be secured.

"These publications will form the basis of special research on separate mining and milling problems which should result in reducing costs and metal losses, and in an increased metal recovery from the nation's mines."

Development Encouraging at Callahan Zinc-Lead

Development of the new south vein in the Galena mine of Callahan Zinc-Lead, Coeur d'Alene district, Idaho, was continued in the east drift during the last quarter, according to D. A. Callahan, president of the company. The drift is now about 400 ft. east of the crosscut. One lens of ore, 40 ft. long, is being stoped at present and is averaging about 5 per cent lead and 5 oz. of silver to the ton. On the 800 level, the crosscut has been driven to within 200 ft. of the vein and should cut it within a month.

Will Drive Long Tunnel Near Eureka, Colo.

Driving of a tunnel 9,000 ft. to develop the extensive acreage it owns about half a mile from Eureka, Colo., will be undertaken by the Martin Syndicate. A 1,700-cu.ft. Ingersoll-Rand air compressor has just been installed and construction of a three-story boarding house, 30x100 ft., is under way. About 30 men will be employed during the winter. The tunnel will measure 9x12 ft. and is expected to cut a series of parallel veins. It will attain a maximum depth of 3,000 ft.

Bunker Hill Cuts Crescent Orebody in Hooper Tunnel

Driving of the Hooper tunnel on the Big Creek and Crescent properties of Bunker Hill & Sullivan, in the Coeur d'Alene district of Idaho, has struck the Crescent orebody about a mile from the portal and 500 ft. below the upper Crescent tunnel. The tunnel has been driven west from Big Creek, near the Big Creek mill, which is being used for treating Crescent ore. Although the Big Creek orebody was not cut in passing through that property, exploration north of the tunnel may be undertaken, as it is also 500 ft. lower than any of the Big Creek workings.

Announce Direct Steamship Sailing to South Africa

A SPECIAL sailing that will provide a convenient and direct trip for those planning to attend the Empire Mining Congress, which will be held in South Africa during March, April, and May of next year, has been announced by the American South African Line. On Feb. 1, 1930, the twin-screw passenger motor vessel, "City of New York," of this line, will sail from New York for Cape Town and other ports in South Africa. The running time to Cape Town is 23 days, including a stop at Bermuda.

The "City of New York" has accommodations for 60 first-class passengers. All the staterooms are large outside rooms, and a number have private baths. Public accommodations include a well-appointed lounge, smoking room with bar, and a barber shop. A physician and a stewardess will be included in the ship's personnel. In the passenger list will also be members of a cruise party that will spend 47 days in South Africa.

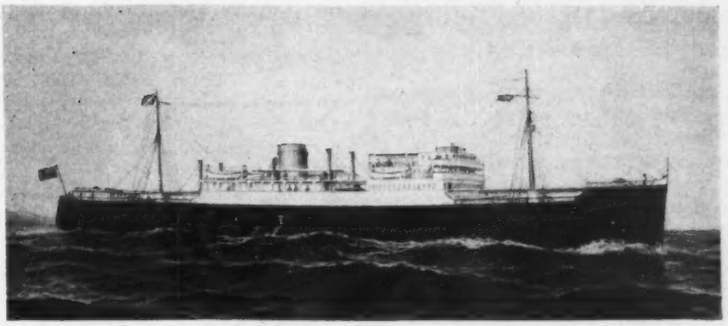
Returning from South Africa, the "City of New York" will leave Cape Town on April 14, 1930. A second departure of the vessel is scheduled from New York on June 1 for South Africa, and from South Africa back to the United States on Aug. 14. Between the sailings of the passenger ship "City of New York," the American South African Line maintains regular monthly sailings to and from South Africa of vessels having accommodations for eight or ten passengers. These vessels include the S. S. "West Isleta," S. S. "Eastern Glen," S. S. "Eastern Glade," S. S. "West Cawthon" and the S. S. "Maine."

Bradshaw Plant to Operate Till Freezing

Operation of the tailing plant of Bradshaw, Inc., on tailing from the Goldfield Consolidated mill, at Goldfield, Nev., will be continued as long as weather permits, according to Mark Bradshaw. So far this season the plant has been operated for 195 days and has recovered $193,504 in gold, silver, and copper. Some very low-grade material was treated in October, and the total recovery for the month was only $29,005.

RHODESIAN DRILLING RESULTS

RHODESIAN CONGO BORDER CONCESSION reports No. NE 15 drill hole, west of the N'Changa property, has struck ore at 184 ft. For 46 ft., drill hole thickness, it showed 14 per cent copper. Core recovery was about 30 per cent. The hole was still in ore when stopped at 230 ft. No. NE 15 hole was drilled about 2 miles southwest of the southwest corner of the N'Changa property, along the strike of the south leg of the N'Changa syncline.



The twin-screw passenger motor vessel "City of New York"

Butte & Superior Developing Northwest Vein at Depth

Development on the northwest vein at the Butte & Superior mine, in the Butte district of Montana, has been almost entirely in ore on the 1,300 level, according to D. C. Jackling, president of the company. Crosscuts to this vein are being driven on the 1,600 and 2,600 levels, but they are not expected to reach it until early next year. Shipments of copper ore, which were resumed in the second quarter, are now at the rate of 30 to 40 tons daily. None was shipped in the first quarter.

Alcalde Gold Sues to Recover Grass Valley Mines

Alcalde Gold Mining, of Grass Valley, Calif., has brought suit against New Monte Cristo Mining to recover title to its properties. Alcalde Gold claims it entered into an agreement with the C. C. Julian company to transfer its holdings for a consideration of stock and assumption of its $30,000 debt by New Monte Cristo. Only a part of the debt has been paid. The property is now idle.

Pilgrim Ships Ore

The first carload of gold ore from the high-grade strike at the Pilgrim mine of Treasure Vault Mining, at Chloride, Ariz., has been shipped to the smelter. The strike has attracted a great deal of attention and about 50 mining men, engineers, and geologists are visiting the mine weekly. In the region surrounding the Pilgrim, much activity is evident. The South Pilgrim is installing a hoist and has let a contract for shaft sinking to Moyle Brothers, of Chloride.

Isle Royale Drains Huron Dam Area

Draining of the area near the Huron dam, in the Michigan copper district, has been completed by Isle Royale Copper. This step was taken to prevent water seeping into the Isle Royale workings. Water for the Huron Copper mill, which was taken over by Isle Royale, was obtained from this area.

To Exploit Placer Deposits in Powell County, Mont.

AN 8,000-cu.yd. Yuba dredge will be installed near Pioneer, Powell County, Mont., next spring to exploit the holdings of Gold Creek Dredging, recently formed by Milwaukee interests. The placers have had very little work done on them, but they have been sampled by means of shafts and pits. Some rich deposits are indicated, which may be worked by hydraulic giants. A large crew is working on the road from Pioneer to Gold Creek, and also reestablishing the old stage road from Pioneer to Deer Lodge.

The Pioneer deposits were discovered in 1858. Crude methods were used, but several million dollars in gold was produced. Most of the ground near Pioneer was consolidated under the ownership of Conrad Kohrs and the Bielenberg brothers, of Deer Lodge. Northwest of that a large acreage was acquired by Patrick Wall. The Kohrs-Bielenberg ground was bought by Harry Symons, Butte merchant. Within the last few months Gold Creek Dredging has acquired both this ground and that belonging to Mr. Wall, who is now in charge of operations.

To Give Course in Non-Ferrous Shop Operation

At the next convention of the American Foundrymen's Association, to be held in Cleveland, May 12 to 16, 1930, a non-ferrous shop operation course for brass foundrymen will be given. The subjects dealt with will include crucible, open-fire, and electric-furnace melting practice.

Tom Reed Starts Mill

Tom Reed Gold started its mill at Oatman, Ariz., early in November, and is treating about 90 tons of gold ore daily. Most of this is coming from the stockpile, where ore has been accumulating from shaft-sinking and development work. Leasers are shipping a little ore to the mill, and some is also being obtained from the new high-grade orebody on the 950 level. Trucks are being used for taking ore to the mill at present, as the rope tramway was put out of commission by an accident. Shaft sinking to 1,500 ft. is under way.

Central Australian Find Proves Disappointing

DISCOVERY of silver-lead and copper deposits in the Jervois Range, 210 miles from Alice Springs, Central Australia, attracted a great deal of interest in Australian mining circles because of the reported tremendous size of the deposits, but examination by engineers and geologists indicates that the field's potentialities were exaggerated.

The first find was made by Thomas Hanlon, a prospector, in June. He staked three claims, 180 acres in extent, on which an option was given to Emu Mining. As the district is a very great distance from transportation—the railroad to Alice Springs from the coast is only projected—reports were slow in filtering through, but several companies were later formed and all the promising ground was staked out.

In the middle of September a party consisting of Colin Fraser, chairman of the board of Broken Hill South; George Klug, director of Electrolytic Zinc; and C. G. Gibson, R. L. Shepherd and James Hebbard, geologists, left for the field by airplane. After examination Mr. Hebbard states that only development can show the extent of the deposits, and that copper is the predominating metal, not silver and lead. He cites the lack of available timber and water as a great handicap to exploitation. However, he believes the deposit to be large. C. G. Gibson recommended that Emu Mining should not exercise its option, as he did not believe that company operation would pay, although independent leasing might be profitable.

Will Diamond Drill at Bendigo Gold Fields

DIAMOND DRILLING will be used in exploration work on the famous Bendigo gold fields of Victoria, Australia, by the Geological Survey of the province, of which W. Baragwanath is director. The saddle quartz reefs of the district occur in the anticlines of crumpled and faulted Ordovician slates. By correlating paleontological evidence, the survey has concluded that these reefs belong to a definite horizon, and that in the overlying and underlying conformable beds of the series, possibility of discovering orebodies is remote. Orebodies were mined over a strike length of 8 miles and to a depth of 3,000 ft. in the district. The exploration will be conducted in those areas where the pitch of the slate bed has prevented the saddle reefs from outcropping.

Enterprise Gold Drilling on Property at Kalgoorlie

Diamond drilling from the 773 level of South Kalgurli Consolidated, in the Kalgoorlie district, Western Australia, is being undertaken by Enterprise Gold Mines, which owns the adjoining property. Crosscutting on the 504 level of the Enterprise mine showed the orebody to be 30 ft. wide at that depth. Permission was then obtained from South Kalgurli to drill from its workings so as to test the orebody at depth. Drilling is also under way on the 360 and 504 level. Although the tonnage proved to date is small, the grade of the ore is estimated at about 42s. a ton. Reconstruction of the company to provide funds for necessary development work is expected.

Frood Shipping More Than 1,000 Tons Daily

WITH the expansion of development work at the Frood mine of International Nickel, in the Sudbury district, Ontario, the quantity of ore produced is increasing steadily. At present more than 1,000 tons daily is being shipped to the Coniston smelter. The largest amount of development work is being done on the 2,800 level, where stopes are now being opened up. About 1,600 men are employed underground, and this number is being increased as development expands.

Good progress is being made with smelter construction at Copper Cliff. The main smelter building is practically inclosed. At the Coniston plant a new sintering plant is being constructed to handle fine ore, flue dust, and concentrate. From 4,000 to 5,000 tons of concentrate a month is being produced at the mill from 12,000 tons of ore.

Will Build Power Line to Nevada Tungsten Mine

POWER for operations of Nevada Massachusetts, operating the Silver Dyke & Tungsten mine, near Sodaville, Nev., will be supplied by the Mineral County electric plant, as the county commissioners recently ratified a contract with the company. A line, 6½ miles long, will be built from the plant to the mine. Operation of the company's new 75-ton concentrator is expected to start as soon as the power line is finished.

A tunnel has been driven 786 ft. to strike the orebody below the workings which produced about $2,000,000 in tungsten concentrate during the war. A raise is now being put up from the tunnel to connect with the Atkins shaft. Drifting on the tunnel level will be started as soon as the tunnel has been driven through the vein to the hanging wall.

Chontalpan Will Close

Closing of the properties of Chontalpan y Anexas, at Chontalpan, State of Guerrerro, Mexico, will take place at the end of November. This property has been in operation for many years, treating a high-grade silver ore. Although its orebodies were believed exhausted as long ago as 1926, sufficient ore was found to keep the mill in operation. The Xitinga unit of the same company, however, continues to operate its new cyanide plant at capacity.

Brown Suggests Means of Stimulating California Mining

ACCORDING to G. Chester Brown, secretary-treasurer of the California Metal and Mineral Producers' Association, production of metals and minerals in California can be stimulated by proper federal tariff revision, decreased mining costs, mining survey by a state agency, elimination of stock swindles, financing of prospects by local groups, and education of the public to become more "mineral-minded."

Mining costs have greatly increased since 1914, and as a result many gold properties cannot operate. Among the excessive costs may be mentioned workmen's compensation. Gold mining has suffered more than any other industry, for the price of gold cannot be increased to meet increased costs. A careful study should be made by federal agencies in an effort to find some remedy. In the Dominion of Canada and in South Africa, a study of the cost of producing gold will be made. Congressman Englebright's bill to exempt gold producers from the federal income tax is important, and if adopted it should assist in obtaining financial aid for this branch of mining. The gold reserve in the United States has been reduced, and gold production is decreasing each year. Although California still leads, its production is also decreasing.

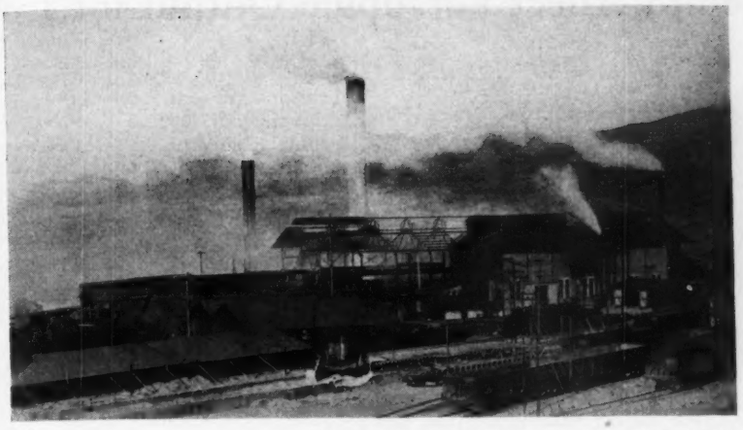
The state legislature has appropriated funds for the State Mining Bureau to inaugurate a mineral survey of California. This is a splendid step toward increasing mineral production. Financing prospects by groups of people in local communities is feasible; it has met with success in Colorado. Moreover, the the work being done can thus be easily supervised.

Michigan Conservation Board Adopts Royalty Basis

A POLICY of disposing of all metals and non-metallic minerals on a royalty basis has been adopted by the Michigan Conservation Commission. Instead of selling mineral rights on its own land and on land which it has disposed of but on which it has reserved these rights, the state will hereafter receive compensation in proportion to the amount of raw materials taken from the ground. Recently the commission adopted a plan for the disposal of oil and gas on a royalty basis. The state now owns approximately 1,500,000 acres of land outright, on which it holds all mineral and oil rights. In addition, it controls the mineral rights on large areas which it has sold in the past.

Capital Adds Third Dredge

The Capital Dredging Company, operating two gold dredges in the Ney district, 6 miles from Folsom, Calif., is preparing to build a third dredge. It has excavated the pit and is now receiving materials for the construction of the hull.



The Southwest Metals smelter at Humboldt

Southwest Metals Smelter at Humboldt, Ariz., to Reopen in January

Plant, Now Controlled by Sheldon Mining, Is Being Remodeled to Treat a Smaller Tonnage of Ore—Development at Sheldon Mine and Mill at Walker Favorable

OPERATION of the Southwest Metals smelter, at Humboldt, Ariz., will be resumed in January, 1930, if the remodeling of the plant continues according to schedule, states H. R. Lathrop, president of Sheldon Mining, which controls Southwest Metals. However, shipments of copper concentrate from the Sheldon mill, near Walker, and of direct-smelting ore from the De Soto mine, in the Big Bug district, will start in December, when the new ore bins at the smelter are expected to be finished. Work of remodeling the plant and changing its capacity from 500 to 250 tons daily will cost about $75,000 when completed.

Sheldon Mining acquired an option on a controlling interest in the Southwest Metals properties last spring. The smelter, which was built in 1913, had been operated intermittently since the World War and had been closed since late in 1926. Lack of ore to maintain operations at or near capacity was the principal cause of the shutdown. When Sheldon acquired control, therefore, the company decided to rebuild the reverberatory furnace to a smaller capacity which could be supplied from the Sheldon 200-ton mill, and from the Southwest Metals properties, the De Soto and Blue Bell mines.

The 350-ton flotation plant, formerly operated in conjunction with the smelter, will not be started this winter. When the plant was last closed down, much of the machinery was sold to other companies. However, it will probably be re-equipped some time in 1930, when the company also expects to resume work at the Blue Bell mine. At the De Soto mine, near Middletown, operations are being conducted by leasers, who are shipping ore to the Hayden smelter of American Smelting & Refining. This ore, amounting to about 50 or 60 tons daily, will be diverted to the Humboldt smelter when that plant is ready to receive it.

In addition to this amount, about 40 to 50 tons of concentrate daily will be available from the Sheldon mill for smelting. The plans of the Southwest Metals and Sheldon companies have been formulated on the basis of treating company ore and concentrate only. Custom ore will be accepted, but as the furnace can be run economically on a charge of 125 tons daily, operations will not depend on obtaining a large tonnage from this source.

At the Sheldon mine, 80 to 100 tons is being put through the mill at present, although the rated capacity is 200 tons. Most of this ore comes from preparatory development work, and as soon as the smelter is ready, mill operations will be stepped up to three shifts. The management has found that only about 170 tons can be treated if recoveries are to be maintained at a high level, and that will probably be the scale of operations in the immediate future.

When the smelter at Humboldt closed down three years ago the Sheldon mill was also closed and the company devoted its energies to development work. The two-compartment shaft, bottomed at 850 ft., was enlarged to three compartments and deepened to 1,250 ft. Developments at depth proved favorable, and early this spring the mill resumed operations on a one-shift basis. The latest advice from the mine is that the south heading on the No. 11 level is in 8 ft. of high-grade ore.

As most of the tonnage sent through the mill is coming from development, the grade handled is rather lower than it will be when a three-shift basis is adopted. Concentration is by flotation methods, and the ratio of concentrate to ore is 1:3. Shipments of concentrate are being made to the United Verde Extension smelter, at Clemenceau. During October, fifteen carloads of concentrate were sent, as compared with only four in May and four in June, when operations were started. Concentrate carries 8 per cent copper, about 15 oz. of silver, and $3 to $4 in gold. Net returns in October, after deducting for freight, smelting, and other incidental charges, averaged $1,084 per carload of about 40 tons.

Concentrate from the mill is washed down a wooden pipe to the drying plant, near Walker, and from there is taken to Poland, 2 miles distant, by the company's narrow-gage railroad. At Poland the concentrates are loaded on to the Santa Fé Railroad cars, whence it is taken to the smelter. At present this branch is being reconditioned and concentrate is being trucked into Prescott for shipment to the U.V.X. smelter. Transportation charges are now about $5.40 per ton. When shipped to Humboldt, only 14 miles from the mill, the company will save over $3 per ton, or approximately $40,000 per year.

George D. French, who has been with Sheldon Mining for the last seven years, is now at Humboldt. He will act as manager for both companies. P. P. Butler, formerly superintendent of the Copper Queen smelter, of Phelps Dodge, has been appointed superintendent of the Southwest smelter.

The Sheldon mine and mill

Dome Fire Not Expected to Affect Porcupine Output for Long

District's Production Probably Will Be Stabilized at About $20,000,000 Annually—McIntyre's New Milling Process Is Development of Greatest Interest to Operators

E. D. Loney,
Special Sudbury Correspondent

TWENTY YEARS have passed since Porcupine, Ont., first attracted recognition as a gold camp, and although numerous efforts have been made—some skillful and some not so skillful—to extend the zone of successful operations beyond that occupied by the large producers, up to the present the great bulk of Porcupine's production has come from three mines, Hollinger Consolidated, Dome, and McIntyre Porcupine. Of the many smaller attempts, the three chief survivals are Vipond, Coniaurum, and West Dome Lake. Each of the three large producers represents the development of the earliest discoveries in the camp. No discoveries have been made since 1910 that have added in an important way to the production figures. Estimated production for 1929, based on returns received by the Ontario Department of Mines, indicates a probable aggregate output this year valued at about $19,000,000, of which all but $1,000,000 represents the output from Dome, Hollinger, McIntyre, and Vipond. Altogether, 23 properties have contributed at various times to the aggregate value of bullion shipped from Porcupine in the last twenty years, and which amounted at the end of October, 1929, to $225,277,102.

Porcupine production figures reached their peak in 1925, when $24,886,615 in bullion was shipped. For two years the decline was scarcely noticeable, and, in view of the ambitious program laid out for its chief producer, further increases were anticipated. The Hollinger fire occurred in February, 1928. Followed a trying period for Hollinger and the entire gold industry of Ontario, and for a time the prestige of the camp suffered. Production last year fell off to $20,352,098 as a result of the readjustment of Hollinger's plans. Signs are apparent that the tide of fortune has again turned. An encouraging feature is that in October, the last monthly returns available, Porcupine production reached $1,921,932. This is the largest output of the year and is higher than the output for any single month since the fire. As Porcupine figures are influenced to a greater extent by conditions at Hollinger than by any other factor, this is accepted as an indication that these have again become stabilized. The loss of the Dome mill by fire in the closing days of October will mean a temporary decline in production amounting to $300,000 monthly, until production is restored to its normal basis, but in view of the projected increases at McIntyre, coupled with improvements at Hollinger, responsible mining men expect production from Porcupine mines to settle for some years above $20,000,000 annually.

Unlike most of the larger Ontario mines, Hollinger Consolidated has not yet adopted the policy of issuing quarterly or monthly statements of production and earnings. Information concerning current developments is consequently meager, with the exception of what can be gleaned from annual reports, the statements of officers at the annual meetings, and the quarterly returns shown by the Department of Mines.

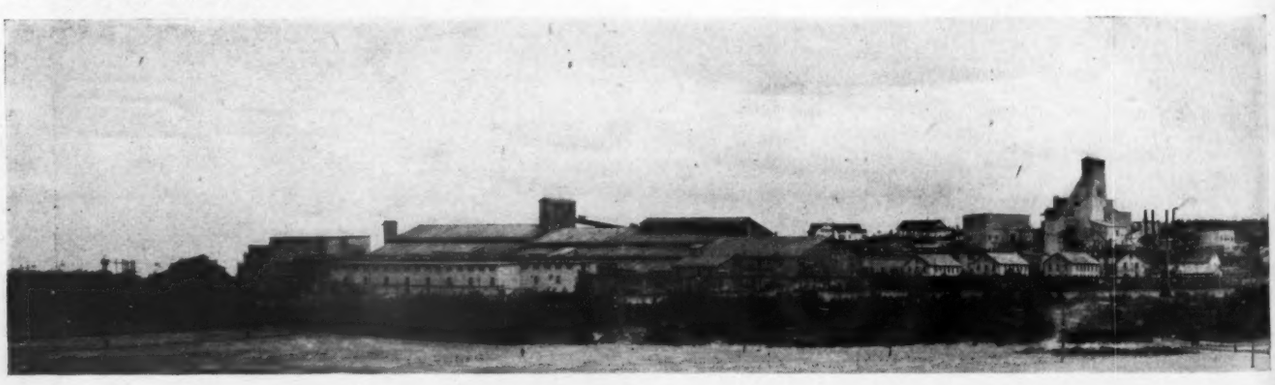
Treating an average of 4,125 tons daily, during the first six months of 1929, Hollinger recovered $4,173,541 from 742,667 tons of ore averaging $5.62 per ton. This compares with a total production for the year 1928, of $10,712,821 from 1,778,470 tons, representing a daily average of 4,982 tons of $6.28 ore. The peak of Hollinger's production was in 1925, when $15,786,405 was recovered from 1,929,988 tons (average 5,312 daily) of an average grade of $8.51 per ton. At present, according to unofficial reports, Hollinger is treating about 4,500 tons of ore daily, with production figures close to $195,000 every seven days, or an output of roughly $850,000 per month.

The fire of 1928 proved to be the turning point for the mine in more than one respect. By correlating company reports for the years prior to 1927, indications are that, in the effort to attain a tonnage of around 8,000 daily from a mine where the ore was contained in numerous veins forming a highly intricate system, considerable dilution of ore with junore took place. The mining policy has since been changed, and, with tonnage established on a more conservative basis, is having the effect of gradually eliminating this condition. Improvement has already made itself manifest in a better grade of ore reaching the mill as shown by production figures for October, and further increases are expected.

The report of Dr. L. C. Graton, who was engaged early this year to make a study of the mine, has not yet been submitted to the directors, according to N. A. Timmins, president of the company, who was interviewed recently. "Everything is going along much better, and I am very hopeful that the improvement will presently be reflected in earnings," he is stated to have added. Net profit from Hollinger operations in 1928 was $3,731,566, as against $6,648,308 the year previous. Ore reserves, according to the annual statement for 1928, were estimated at $51,210,235, ranging in grade from $4.75 to $11.80 per ton.

McIntyre Porcupine Mines, adjoining Hollinger to the east, finds its ore under similar geological conditions as those which govern Hollinger deposition, except that McIntyre enjoys the benefits of the easterly rake of the porphyry intrusions and consequently finds its important ore at deeper horizons. A long awaited and significant stage in the development of McIntyre was reached this week, when preparations were completed for hoisting the entire ore production of the mine through No. 11 shaft, the new 4,000-ft. unit completed about two and a half years ago at a cost of $2,000,000. Direct haulage connection has now been established between No. 11 shaft and the western part of the mine at the 1,875, 2,375, and 2,875 levels. Ore from No. 11 shaft will pass through a primary crushing plant and be transported by locomotive to No. 6 shaft and thence by cable tramway across Pearl Lake to the mill. No. 6 shaft will be partly retimbered and re-equipped for a service shaft for men and materials. No. 5

The Hollinger surface plant



shaft will be converted next spring into an air shaft and a fan ventilating system will be installed.

This program, which was outlined officially to me, means that the heavy development program in which McIntyre Porcupine has been engaged for the last two years and a half is now about to come into fruition and is likely to pave the way for an increase in mill tonnage, expected next spring. Ore reserves of $16,000,000 were reported at the end of the company's fiscal year, March 31, 1929, but this estimate included very little ore below the 2,875 level. At present there are 33 faces in ore ready for driving on levels between 1,625 and 3,875. Owing to the limited mill capacity, ore for production will continue to come from the western section of the mine and practically all from above the 2,875 level. Ore from below this horizon will be confined to development rock, as practically no stoping will be done in this territory for the present. Officials emphatically reiterate their denial of rumors to the effect the geological conditions have changed at the lower levels.

The Coniaurum surface plant

After the fire at the Dome mill

Apart from mining, McIntyre is engaged in important experimental work with the new process evolved by its mill superintendent, J. J. Denny, for reduction of gold ores, by which officials hope to be able to reduce the capital cost of mill construction by at least 50 per cent and the cost of milling by about 25 per cent. The process, I understand, involves concentration of the ores by flotation methods. If present tests on a 100-ton pilot mill are successful, a 99 per cent recovery of the gold is said to be assured. An official statement is to the effect that since the test mill started operating last week mill production has increased from 1,500 tons to 1,600 tons per day. Mill heads are being maintained in excess of $8 per ton. The proposed increase in tonnage is expected to bring mill capacity up to around 3,000 tons per day.

Although the question of whether Dome Mines will rebuild the mill which was destroyed by fire on Oct. 28, or make an arrangement to utilize the excess milling capacity of neighboring companies, has not yet been settled, the feasibility of an arrangement with Hollinger Consolidated in this connection is being thoroughly investigated. Insurance for the loss of the mill will amount to about $800,000. The question of rebuilding is a somewhat intricate one. Were Dome a young mine, with an indefinite span of life ahead, no delay would occur in clearing away the wreckage and rebuilding. With only a limited number of years of production in sight, the utilization of Hollinger's surplus capacity suggests itself. This would entail a cable tramway, 3 miles long, and the possibility that the buckets of wet ore would freeze solid in winter. The Dome ore also contains more pyrrhotite than the Hollinger ore and several changes would have to be made in the Hollinger mill to make the plan operative. Experts of both companies are investigating this phase of the situation. Freight rates over the T. & N. O. Railway have also been secured.

Dome is watching with keen interest the results of McIntyre's experiments with its new process for reducing ore. Regardless of whether a new mill is built or Dome ships its ore to a neighboring property, a delay of not less than three months in resuming production is expected. In the meanwhile every effort is being made to retain as many of the married men as possible on the payroll. The number of employees, which before the fire was 670, is now more than 400. Advantage is being taken of the opportunity to make certain desired changes in the mine. Development of the greenstone orebodies is being pushed vigorously and a drive has been started to prove diamond-drill intersections obtained on the No. 23 level, the deepest horizon in the mine. This is at least 1,000 ft. deeper than the bottom of the sedimentary trough in which the bulk of Dome ore has been found to date. Production of Dome Mines, up to the end of October, was about $300,000 monthly from a mill capacity of 1,500 tons per day.

Vipond Consolidated, which lies south of Hollinger in the Porcupine field, has made several outstanding discoveries of late that have materially improved its prospects. One of these is in the No. 9 vein area, where a productive zone was encountered which extended from the 500 level to a depth of 866 ft. and in which reserves of $1,000,000 have been put in sight. Another was the discovery that one of Hollinger's veins extended across the boundary at the 400 level.

Among the other developments in progress at Porcupine the most important is Coniaurum Mines, east of McIntyre. This company was sponsored by Coniagas Mines, of Cobalt, and was placed in the hands of a receiver early this year. Later operations were taken over by Ventures, Ltd., and the mine has been operating at a small profit since February. Development work has been curtailed. Value of output is reported as $60,000 per month from 230 tons of ore treated daily.

At the extreme eastern end of the producing section, West Dome Lake Gold Mines, and March Gold continue to operate on a small scale. United Porcupine Gold Mines, owned by interests associated with the March Gold, has produced a small amount of gold. Two mills, Porcupine Paymaster and Ankerite, suspended operations during the year.

International Smelting to Sink Park City Shafts

Depth exploration will be undertaken through the Park Konold and Park Premier properties of International Smelting, Anaconda subsidiary in Utah, at Park City, Utah. The Park Konold shaft, now 365 ft. deep, will be enlarged to two hoisting compartments and a manway, and sunk through the rhyolite formation into the underlying sedimentaries. A drill hole, put down near the shaft, cut limestone for 450 ft., of which 250 ft. showed heavy iron mineralization. The Park Premier shaft, of two compartments, will be sunk near the Victory tunnel at Keetley, the Park Utah community. It will be sunk in a limestone outcrop, from which assays showing low-grade silver, lead, and gold have been obtained.

A.S.&R. Acquires Mines in American Fork District

Operations of the Yankee, Silver Wave, and Bellorophan properties, in the American Fork district, 50 miles southeast of Salt Lake City, Utah, will be undertaken at once by American Smelting & Refining, which has acquired stock control of the Yankee company and purchased the Bellorophan and Silver Wave. Crude copper-silver-gold ore has been shipped from these properties for several years and mill-grade ore has been treated in a small gravity concentration plant. Systematic development of favorable geologic features will be undertaken by American Smelting & Refining.

Chief Con. Flotation Plant Handling 150 Tons

About 150 tons daily is being handled in the Chief Consolidated flotation plant, Tintic district, Utah. This is oxidized ore, and is being treated at a profit. The tonnage is too small, however, to permit working the combined system of volatilization and flotation. When the capacity of 500 tons daily is approached, however, the combined system will be put into operation. About 10,000 ft. of development work was done in the third quarter of 1929 in the company's properties. Results have been satisfactory, according to Walter Fitch, president of the company.

Tonopah Extension Developing Ore at 1,500 Ft.

Tonopah Extension has suspended work on the 1,880 level at its mine, Tonopah, Nev., and is devoting its attention to a new orebody opened above the 1,540 level at the west. A drift from the top of a 40-ft. raise from this level is said to have opened an orebody of which 2 ft. is high-grade ore. The first orebody in this section, opened a long time ago, was 15 ft. wide and extended 200 ft. above the 1,540 level. The new find is in the 1,531 vein.

Shaft Sinking, Pumping, and Open-Pit Mining Discussed by Utah Section

J. Fred Johnson, of Chief Consolidated; Leonard Wilson, Consulting Engineer, and Louis Buchman, of Utah Copper, Make Addresses Before Regular Monthly Meeting in Salt Lake City.

GAIL MARTIN
Special Salt Lake City Correspondent

SHAFT-SINKING, pumping, and mining practice at the Utah Copper mine were the subjects of discussion at the regular monthly meeting of the Utah section of the A.I.M.E. on Thursday, Nov. 14, at the Hotel Newhouse, in Salt Lake City. J. A. Norden, chairman of the section, presided. J. Fred Johnson, general superintendent of Chief Consolidated; Leonard Wilson, consulting engineer of Salt Lake City; and Louis Buchman, assistant superintendent of Utah Copper, were the speakers.

Sinking methods, Mr. Johnson said, should be sufficiently flexible to meet the peculiar conditions of geology, equipment, and labor. No hard and fast rules can be made, therefore, except that each man on the crew must have a definite routine. The usual method of letting men take turns at whatever work has to be done is uneconomic, he declared. Labor costs in shaft sinking should range from 20c. to 40c. a cubic foot, and explosive from 2c. to 6c., according to the nature of the ground. Raising generally costs from half to two-thirds as much as sinking, within the limits of a reasonable distance, not to exceed 500 ft.

Mr. Johnson stressed the economy of using a mucking pan and extension shoes to let the cage to the bottom. In Butte, he declared, by using a mucking pan the contract price had been reduced from $45 to $40 a foot without cutting the earnings of the men. In some formations the pan cannot be used. In bad ground, Mr. Johnson said, putting down two small shafts, rather than one large shaft, is favored, because the cost of keeping a large shaft open is heavy in comparison with maintenance cost for two small shafts. He cited the Morning shaft, at Mullan, Idaho, where 40 men are employed daily in keeping the shaft open. With labor figured at $275 and materials at about $125 daily, the yearly cost for this four-compartment shaft is about $125,000. Trouble at this shaft resulted from a quartzite formation that caved badly when left open to the air, although it presented no difficulties in sinking. One 200-ft. stretch had to be retimbered three times. Cedar blocks are placed between the long blocks and the wall plates. The cedar blocks, being softer than the long blocks, crush first. They are replaced by new cedar blocks and the long blocks are thus saved undue strain. In similar ground at Butte, concrete has been used with notable success in the Speculator shaft behind the sets. Rock is thus sealed off and the air and moisture cannot cause swelling.

From this practice, Mr. Johnson conceived the idea of filling the lagging behind the sets with sand. This practice has been applied in a 125-ft. shaft and a 125-ft. raise at the Hecla mine. The filling is put in a trough and a stream of water introduced at the upper end to carry the sand down the shaft through a 2-in. pipe. Hose is used to discharge sand behind the shaft. Temporary blocking was used and, as the level of the filling rose, the blocks were knocked out. After nine months these workings showed perfect alignment and no increased pressure.

The most economical speed for sinking is from 100 to 125 ft. monthly. At its Water Lily shaft, Chief Consolidated sunk 427.5 ft. in 30 days and 1,325 ft. in four and a half months. Double hoisting, with two hoisting engineers, and a steel and timber protected bulkhead for timbering were used. Mr. Johnson advocated the use of electric firing of blasts and No. 1 delayed caps, which have a decided advantage in saving retimbering as compared with instantaneous caps.

In discussing pumping, Leonard Wilson stressed the desirability of using compact accessible centrifugal pumps. Units of equipment should occupy a minimum of space to cut cost of underground stations, he declared. They should be selected so that no actual repairs need be made underground. Parts subject to wear or failure should be easily removable as a unit assembly. Power efficiency is also of the utmost importance. Mr. Wilson cited the example of a centrifugal pumping unit, of 500 hp., having a lost-power equivalent of $6,000 annually. A cheaper unit might have losses of $10,000 annually, although the installed cost was only $3,000 less. On the other hand, a super-efficient unit could be designed that would have a loss of only $5,000 annually, but it would cost $30,000 more than the first unit.

To overcome the danger, noise, and inefficiency of the usual suction pump in shaft sinking, Mr. Wilson advocates use of a light suction unit called an "electrical sponge," set on top of the muck pile. The complete device, with a 5-hp. induction motor, weighs only 200 lb. and has a height of 21 in. and a diameter of 12 in. This pumps the water to the booster unit, mounted on a light crosshead running on guides supported on the wall plates. Discharge is through a 2½-in. rubber hose. The

crosshead is operated by a baby hoist that lifts the complete equipment. The sponge pump is connected to the crosshead by 25 ft. of wire and 25 ft. of connecting water hose. A pull switch starts the motor, which stops automatically as soon as the water has been pumped.

Park Utah's new pumping units were cited by Mr. Wilson as examples of installations that pump from below water level. This system allows economical unwatering of a mine flooded to its natural drainage level. The highest level motors are above the drainage level, so that their pumps can unwater the motors on the next lower levels. These can be dried out in position and the process continued to the bottom level. At Park Utah, three Byron-Jackson deep-well type, centrifugal pumps of 2,700 g.p.m. have been installed. Motors are on the 1,800 level and pumps on the 1,950 level. A special pump shaft accommodates the three pump columns.

For main pumping from water level to water outlet, the centrifugal pump is most efficient, Mr. Wilson stated. Increase in efficiency from about 65 per cent before the war to from 80 to 90 per cent at present has made the single-stage volute pump the most highly favored. Mr. Wilson cited a single-stage pump at Park Utah as an example of the efficiency that can be attained. It is driven by a 500-hp. variable-speed motor, has Stellite rings, packing box lubricated by hydraulic grease, and a 7-ft. gravity head. Its rated capacity is 4,500 g.p.m. at 300-ft. head. Its efficiency has been 85 per cent, and it has been in continuous operation for one year without any signs of wear.

The important question of the total head that can feasibly be handled using single-stage units resolves into a comparison between single-stage units operating in series and high-head, multi-stage turbines, which can be designed for the highest heads required. However, it has much lower efficiency than the single-stage volute pump.

The single-stage unit impeller is well suited for any head up to 300 ft. Above this, limitations arise from the resulting high water velocity. For total heads in excess of 300 ft., Mr. Wilson advised that pumps located on each of the upper stations be at least 100 ft. under their theoretical heads. For a head of 1,200 ft., there should be four 300-ft. stages with stations at 1,200, 1,000, 700 and 400 ft., so that each station receives the water at positive head of 100 ft. and discharges it at a head of 400 ft. This eliminates instability resulting in cases where the one pump takes water too fast. Total flow can be regulated by throttling or speed adjustment at any one station.

Problems peculiar to the Utah Copper mine, at Bingham, were discussed by Louis Buchman. After describing the geology and mineralogy, Mr. Buchman discussed the physical outlines imposed by open-pit mining. From 75 to 150 ft. of stripping had to be done before the ore could be shoveled. As of Jan. 1, 1929, 625,000,000 tons of ore was estimated developed at Bingham, with about 176,000,000 tons mined and about the same tonnage of overburden stripped. Before operations ceased at Bingham, Mr. Buchman said that probably 1,000,000,000 tons would have been mined.

Air is supplied by three Ingersoll-Rand compressors with a combined capacity of 11,000 cu.ft. per minute. A 6-in. pipe encircles both sides of Bingham Mountain and is connected with T and L sections by 2-in. pipe, thus preventing any shutdown because of lack of air except stoppage of the compressors. Ingersoll-Rand F 24 piston drills, mounted on tripods, a type in use for the last twenty years, are still used for drilling. Nearly every type of drill has been tried. Some of the other types make faster progress for the first 8 ft., but soon get wedged, so that great difficulty is had in freeing the steel.

Ammonium nitrate, slow in action, non-freezing, and safe to handle, is used for blasting. The amount averages about ¼ lb. to the cubic yard of rock. Two general power foremen, with an assistant foreman to each two shovels, direct the blasting.

Mr. Buchman testified to the superiority of electric shovels and electric haulage as compared with the same operations by steam. In 1927, an average of 1,027 cu.yd. was handled per shovel, and in 1928, 1,858 cu.yd., an 80 per cent gain. Manganese steel dippers, with a capacity of 4½-cu.yd., have been found superior on the shovels. Power consumption is about 1 kw.-hr. to 2¼ cu.yd. Power consumption at the mine is 20,000,000 kw.-hr. per month. The maximum output of ore and waste for any one day stands at 141,586 tons, 68,000 tons of waste and 73,000 tons of ore. If necessary 100,000 tons of ore can be mined daily.

The problem of moving this tonnage and keeping 50 trains moving over 80 miles of track is considerable, according to Mr. Buchman, particularly when 2 or 3 ft. of snow falls in short periods of time. Nordberg spreaders and track movers aid materially in smoothing newly dumped material and providing new trackage.

Nevada Con. Completes New Pipe Line

LAYING of 8½ miles of copper pipe, having a capacity of 15,000 g.p.m., to connect the metallurgical plants of Nevada Consolidated, at McGill, Nev., with the company's Duck Creek water supply, has been completed. The pipe was fabricated in the company's plants, in 37-ft. joints, from $\frac{3}{16}$-in. sheet alloy of copper and steel, that is resistant to corrosion and temperature changes. The new line, completed after two years of work, leads by gravity flow from the Duck Creek plant, where 60,000 ft. of inlet empties streams of 8 and 19 in. each into the 1,000,000-gal. surge tank at the McGill concentrator. The pipe was dipped in hot asphalt and then coated with aluminum paint. Brass expansion joints are provided every 1,000 ft. The line rests on concrete foundations.

San Francisco Section Meets at Stanford

ON NOV. 12, 1929, the San Francisco section of the A.I.M.E. held its regular meeting at Stanford University. The faculty of the mining department and graduate students attended the meeting. Dean Theodore J. Hoover presided. He commented upon the six-year plan of university instruction that is now the order at Stanford University in engineering, four years of undergraduate work and two years of post-graduate study. The plan is based upon the idea that the engineer is something more than a technician and that consequently a broad training is essential.

Welton J. Crook, professor of metallurgy, gave many interesting sidelights upon his recent trip to France, Italy. Germany, and England. He discussed people, politics, and metallurgical plants, the police bureau of Paris, and touched upon Monte Carlo. Dr. C. F. Tolman. professor of economic geology, dissected the character and abilities of the economic geologist in his relations to the mining industry. He claimed that the geologist is an optimist, and that his imagination is therefore a foil to the practicability of the mining engineer. At the conclusion of the meeting the laboratories of the mining department were visited.

Mason Valley Mine May Ship Ore to Utah

The Mason Valley mine at Mason, Nev., has been reopened by Eastern Iron & Metal. Ore will be mined from the carbonate stopes by leasers and shipped to the Garfield plant of American Smelting & Refining. Pending an examination of the properties, according to Morris Rosenblatt, president and general manager of Eastern Iron & Metal Company, dismantling of the flotation plant, at Mason, and the smelter, at Thompson, has been stopped.

Build Mill at Goldstone

Construction of a 100-ton flotation plant is now under way at the property of Goldstone Mines, near Baker, Idaho. A. J. Theis & Company, of Seattle, controls the property. Work is being pushed so as to have the mill in operation by Christmas. Tests made on the ore, carrying free-milling gold, by A. W. Fahrenwald and W. L. Zeigler, have shown high recovery. E. W. Berry, mechanical engineer for A. J. Theis & Company, designed the flow sheet. Andrew Brader is superintendent. Fahrenwald flotation machines and a Hardinge ball mill will be used.

MARKET AND FINANCIAL NEWS

Good Earnings Result in Continued High Dividend Disbursements

THE sums distributed to stockholders in dividends during November again emphasized the highly satisfactory state into which the mining industry has emerged this year. Disbursements for the month reached the huge total of $37,359,893, which compares with $34,060,240 paid out by the same companies in August, the nearest comparable period. In November, 1928, when all but two or three major companies listed in the subjoined tabulation were included in the total of disbursements, the dividend payments amounted to $19,247,397.

Copper companies were the chief contributors to the rise in dividends. An active call for copper at substantially higher prices than those which have obtained in recent years brought about this turn for the better. The monthly average price of copper in the New York market, net refinery, for the first ten months of the current year was 18.173c. per pound, against 14.371c. for the similar period last year. Lead and zinc prices also were higher than last year, covering the same period, but the increase was not so pronounced. In silver the trend has been downward, the price falling below 50c. per ounce for the first time since the World War.

The sharp decline in security markets in October is reflected in the higher annual per-cent yield of mining and metal shares. One effect of the stock market crash is the transfer of stocks from the hands of wild speculators to sound investment channels. The yields shown in this month's compilation are based on security quotations which prevailed early in November. Such issues as Anaconda, Miami, Freeport Texas sulphur, Andes Copper, Cerro de Pasco, and Granby all fell to a point where the dividend yield was well in excess of 7 per cent per year on payments actually made in the past twelve months.

Company reports announced recently indicate that the high rate of general manufacturing activity which has been in evidence since the beginning of the year has been well shared by the mining and metal industry. The National City Bank, in a study of earnings of American corporations, finds that fourteen metal-mining companies reported net profits of $30,476,000 in the first nine months of 1929, against $21,400,000 in the same period last year, a gain of slightly more than 42 per cent. Earnings of the same group of companies in the third quarter of 1929 showed a gain over the figures for the corresponding period last year of 32.2 per cent.

***E. & M. J.* Compilation of Mining Dividends and Yields for November, 1929**

Companies in United States	Situation	Per Share	Total Disbursements	Annual Per Cent Yield
American Smelting & Refining Co.	Various	$1.00 Q	$1,829,940	5.2j
Anaconda Copper, c.s.l.s.	Various	1.75 Q	14,096,672	7.7j
Bethlehem Steel Corp.	Various	1.50 Q	3,604,348	4.0j
Bunker Hill & Sullivan, l.s.	Idaho	0.75 MX	245,250	7.8j
Colorado Fuel & Iron, pfd.	Various	2.00 Q	40,000	6.3j
Freeport Texas, su.	Texas	1.00 Q	729,783	12.2j
Homestake Mining, g.	S. Dakota	0.50 M	125,580	9.2j
Miami Copper	Arizona	1.00 Q	747,134	10.6j
National Lead "B"	Various	1.50 Q	154,913	5.1j
Nichols Copper "B"	Various	0.75 SA	70,000	....
New Jersey Zinc	Various	0.50 Q	981,631	2.7j
United States Steel, pfd.	Various	1.75 Q	7,214,920	5.0j
United Verde Extension, c.	Arizona	1.00 Q	1,050,000	28.8j
Utah-Apex, c.l.z.	Utah	0.25	132,050	....
Vanadium Corp.	Various	0.75 Q	283,775	5.5j
Companies in Other Countries				
Andes Copper	Chile	0.75 Q	2,320,000	8.3
Amparo Mining, g.s.	Mexico	0.01 Q	20,000	....
Cerro de Pasco, c.s.	Peru	1.50 Q	1,684,263	8.3j
Granby Consolidated, c.	Br. Col.	2.00 Q	893,206	11.6j
Hollinger Consolidated Gold	Ontario	0.05 M	246,000	12.0
International Nickel, pfd.	Ontario	1.75 Q	158,959	5.8j
Lucky Tiger-Combination, g.s.	Mexico	0.025 M	17,895	13.1j
Teck-Hughes, g.	Ontario	0.15 Q	713,574	11.1j
Total			$37,359,893	

s, silver; l, lead; z, zinc; c, copper; g, gold; n, nickel; Q, quarterly; M, monthly; MX, 25c. monthly and 50c. extra; SA, semi-annually; j, based on dividends for last twelve months.

Nickel Earnings in Quarter Placed at 37 Cents a Share

INTERNATIONAL Nickel Company of Canada, Ltd., including Mond Nickel Company, Ltd., reports for the quarter ended Sept. 30, 1929, a net profit of $5,627,577 after depreciation, depletion, interest, and federal taxes, equivalent, after dividend requirements on 7 per cent preferred stock, to 37c. a share on 13,758,208 no-par shares of common stock, comparing with $5,647,984, or 38c. a share, in the preceding quarter. In the third quarter of 1928, the International Nickel Company, excluding Mond Nickel Company, Ltd., reported a net profit of $3,218,249, equal, after dividend requirements on 6 per cent preferred stock, to $1.84 a share on 1,673,380 shares of common stock then outstanding.

Net profit in the first nine months of 1929 totaled $16,865,753 after above charges, equal to $1.11 a share on common stock. In first nine months of previous year net profit of International Nickel, excluding Mond Nickel, was $8,304,771, equal to $4.72 a share on 1,673,380 common shares.

Higher Freight on Lead

THE Interstate Commerce Commission has suspended until June 15 the operation of the proposed increased rates on lead and lead residues, carloads, from points in Central Freight Association territory and Western terminal points to destinations in Eastern and New England territories. The effect of the proposed increase is seen in the following comparison of present and proposed rates: The rate from New York City to Toledo would be increased from 25 to 29.5c. per 100 lb.; from Akron, 25c. to 27c., and from Pittsburgh, 19c. to 23c.

Nevada Consolidated Profit Shows Gain in Quarter

NEVADA Consolidated Copper Company and subsidiaries report for the quarter ended Sept. 30, 1929, a profit of $5,517,409 after ordinary taxes and depreciation, but before depletion and federal taxes, comparing with $3,786,253 in the preceding quarter and $4,649,695 in the September quarter of 1928. Profit for the first nine months of 1929 totaled $16,028,181 before depletion and federal taxes, against $10,368,093 in the first nine months of the previous year.

Production of copper from all sources for the third quarter was 60,190,553 lb., against 72,616,900 lb. in the second quarter and 78,381,000 lb. in the first quarter. Cost of producing copper in the third quarter, after crediting gold, silver, miscellaneous earnings, and income from subsidiaries, was 9.32c. a pound, 8.96c. for the first quarter.

London Financial News

W. A. Doman

Special London Correspondent

London, Nov. 5, 1929—Base metals are on the down grade, and at the time of writing are quoted as follows: Copper, £69 17s. 6d.; lead, £22 3s. 9d.; tin, £180 2s. 6d.; and spelter, £21 17s. 6d. These prices compare with £75 5s. £22 7s. 6d., £225 10s., and £26 15s., at the beginning of the year. The present fall has naturally had its effect on share prices, and even Rhodesian coppers, which are so well held and supported, have suffered. American interests in these companies, however, are very large, and shares in them have been bought not for today or tomorrow, but for the long shot.

In a conversation I had with the London representative of one of the most important American companies, he told me, when asked what was the matter with a certain Rhodesian mine, that so far as he knew there was nothing wrong, and that his company held thousands of shares and was not selling. Everyone agrees that the metal is there, and when the suggestion is made that prices of shares have discounted possibilities years ahead, the remark is: We do not think so; wait and see. To the pessimists—and there are some—the answer is: Would the Rothschilds, the Rio Tinto, the Union Corporation, and American firms have staked such large sums of money, as well as their reputations after examination by their own engineers, if the deposits did not exist? When difficulties such as the flat, spongy nature of the ground, and labor, are mentioned, the reply is that science can overcome everything. The figures of tonnages "proved" are truly colossal, and one wonders what will happen in two or three years' time when the output is hundreds of thousands of tons of copper annually. Union Minière draws much of its labor from Rhodesia, and to keep it at home the Rhodesian authorities are credited with the intention of forbidding native recruiting.

The Mufulira mine is to be organized as a separate company with a capital of £600,000 in 2s. shares. There are already indicated 40,000,000 tons of 4.7 per cent copper sulphide ore, the richest development to date in Northern Rhodesia. The company expects to deal with 2,000,000 tons of ore per annum, and to have an output of 75,000 tons of copper. It plans to attract British miners to its African properties.

The Mining Trust, Leslie Urquhart's creation, has issued a most encouraging progress report. At Mount Isa, in Queensland, the ore reserves are estimated at 24,285,000 tons of a value approaching £80,000,000. Interested parties are wondering what the Consolidated Mines Selection, which first had the proposition in hand, are thinking. Wonderful values have been discovered in the New Guinea gold fields, and work is progressing at a fairly rapid rate.

At the annual meeting of the Panama Corporation, Hugh Marriott, the consulting engineer, gave a most glowing account of the position and prospects. Another subsidiary is soon to be floated, but whether American capital will be interested seems to depend upon the Wall Street position.

Clarifying the Position of American Metal

Harold K. Hochschild, vice-president of The American Metal Company, Ltd., writes that certain unfounded implications regarding The American Metal Company, Ltd., and enterprises in which that company is interested, are contained in the article by Dr. James Rubinfeld, special Berlin correspondent, published on page 792 of the issue of Nov. 16. Mr. Hochschild wishes it understood that:

"1. No plans for electrolytic refining have yet been made by the principal Rhodesian copper companies in which The American Metal Company, Ltd., is interested. It may be assumed that if and when such plans are made authoritative announcements will be forthcoming from the head offices of the respective companies in London, and not from any other source.

"2. The sale of the copper production of the International Nickel Company of Canada is, through a long-term contract, under the sole control of The American Metal Company, Ltd.

"3. A part of the copper sold by The American Metal Company, Ltd., in Germany is disposed of through Aron Hirsch & Sohn as selling agent. There is no other connection whatever between the two companies."

Teck-Hughes Net Lower

Teck-Hughes Gold Mines, Ltd., reports for the year ended Aug. 31, 1929, net income of $2,543,518 after expenses, depreciation, and federal taxes, equivalent to 53c. a share on 4,777,144 shares of capital stock. This compares with $2,617,492, or 55c. a share, on 4,767,144 shares in the year ended Aug. 31, 1928. Deficit after dividends for the year amounted to $321,268, comparing with a surplus of $472,277 in the previous year.

Lake Shore Mines, Kirkland Lake, declared a quarterly dividend of 30 per cent, payable Dec. 16 to stockholders of record Dec. 2.

Copper Shipments by Boat out of the Michigan district in October totaled 8,686,000 lb. Calumet & Hecla Consolidated shipped 4,906,000 lb., and 3,740,000 lb. was loaded at the Michigan smelter, representing Copper Range, Mohawk and Isle Royale metal. Quincy shipped only 40,000 lb. by boat.

Butte Copper & Zinc Company declared a dividend of 50c., payable Dec. 24 to stock of record Dec. 9. Previous dividend of 50c. a share was paid in December, 1926. Production for October was 15,500 tons, of which 6,940 tons was manganese and 8,600 tons, zinc ores.

Stocks of Copper Decline Slightly in October

October copper statistics showed a reduction in total stocks of blister and refined of 4,921 tons, compared with September. Daily rate of production was about the same as in the preceding month. Domestic shipments amounted to 105,729 tons, which compares with 105,860 tons in March, the high for the year. A summary of the figures for October, with a comparison, as compiled by the American Bureau of Metal Statistics, follows:

Refined Copper Production, Shipments, and Stocks—North and South America

	October 1929	Jan.-Oct 1929
Production:		
Primary	140,311	1,437,051
Scrap	12,529	91,227
Total	152,840	1,528,278
Daily rate	4,930	5,027
Shipments:		
Exports	53,461	513,063
Domestic	105,729	992,280
Total	159,190	1,505,343
Stock, Aug. 31	88,401	.....

Summary of Copper Statistics in September and October

	September 1929	October 1929
Production:		
U. S. mines	79,402	82,575
Blister, No. America	104,595	109,659
Blister, So. America	30,801	31,152
Refined, No. and So. Am.	134,343	152,840
World, blister basis	174,553	.....
Stocks:		
No. and So. America—		
Blister and in process	253,519	254,948
Refined	94,751	88,401
Total	348,270	343,349
Great Britain, total	8,716	7,744
Havre	7,815	6,217

Distribution of United States Copper Production

	September	October
Porphyry mines	30,927	32,265
Lake mines	7,738	8,146
Vein mines	34,504	36,264
Custom ores	6,233	(a) 5,900
Total crude production	79,402	82,575
Daily rate	2,647	2,664
Imports in ore and matte	9,683	.....
Blister from scrap	3,275	.....
Smelter production	92,538	.....

(a) Partly estimated.

Calumet & Arizona Income for Nine Months $7,805,175

Calumet & Arizona's net income, before depreciation and depletion, for the first nine months of this year was $7,805,175. The report for the September quarter and the nine months ended Sept. 30, including the production and income of the New Cornelia Copper Company, follows:

	Quarter Sept. 30.	Total for Nine Months
Production:		
Copper, pounds	30,519,214	100,875,676
Silver, ounces	462,123	1,492,954
Gold, ounces	14,558	47,872
Gross income, sales and other sources	$6,871,335	$19,386,837
Net income before depreciation and depletion	3,309,234	7,805,175

In October the company produced 10,412,000 lb. of copper.

The Market Report

Active Call for Lead—Copper Dull

New York, Nov. 20, 1929—Outstanding in the market for non-ferrous metals was the activity in lead, the sales volume for the week being well above the average. Copper, zinc, and tin remained quiet. So far as prices were concerned no important changes took place. Copper producers were firm in maintaining the market at 18c. Lead appears to be in a strong position. Zinc sold in a small way at a decline of five points, although the reduction in price was by no means general. Tin was fairly active abroad, but dull here. Antimony was in somewhat better demand and slightly higher.

Demand for Copper Dull

Demand for copper was extremely dull, but the business in which producers participated was at the unchanged price of 18c., delivered in Connecticut, and 18⅛c. in the Middle West. Shipments to domestic consumers are holding at a good level, despite the feeling of uncertainty obtaining in most quarters in regard to the general state of business. The improvement in Wall Street, coupled with the constructive developments in Washington, helped matters considerably, but the uplift in sentiment has not yet resulted in a resumption of buying. The appearance of some resale copper at slight concessions attracted widespread attention. Second-hand offerings, however, were not sufficient in volume to bring about a change in the general situation. Producers believe that they have the market well in hand and that business in copper will pick up soon, especially for export. Business in copper wire and sheets has not suffered so much as brass, which reflects reduced operations in the automotive industry.

Export demand also was quiet. Sales for foreign account made so far this month total about 12,000 tons. Copper Exporters, Inc., quote the market unchanged at 18.30c., c.i.f. European ports.

World production of copper in October was 178,269 tons, according to the A.B.M.S., against 174,553 tons in September, and 196,820 tons in April, the high for the year. The daily rate of production, however, was lower than in the preceding month, being 5,751 tons, against 5,818 tons in September.

Daily Prices of Metals

Nov.	Electrolytic Copper	Straits Tin	Lead		Zinc
	Refinery	New York	New York	St. Louis	St. Louis
14	17.775	40.00	6.25	6.10	6.25
15	17.775	39.875	6.25	6.10	6.25
16	17.775	40.00	6.25	6.10	6.25
18	17.775	40.125	6.25	6.10	6.25
19	17.775	39.875	6.25	6.10	6.20@6.25
20	17.775	40.00	6.25	6.10	6.20@6.25
	17.775	39.979	6.250	6.100	6.242

Average prices for calendar week ending November 16, 1929, are: Copper: 17.775c.; Straits tin, 39.583c.; New York lead, 6.250c.; St. Louis lead, 6.100c.; zinc, 6.250c.; and silver, 49.438c.

The above quotations are our appraisal of the major markets for domestic consumption based on sales reported by producers and agencies. They are reduced to the basis of cash, New York or St. Louis, as noted. All prices are in cents per pound.

Copper, lead, and zinc quotations are based on sales for both prompt and future deliveries; tin quotations are for prompt delivery only.

In the trade, copper prices usually are quoted on a delivered basis; that is, delivered at consumer's plant. As delivery and interest charges vary with the destination, the figures shown above are net prices at refineries on the Atlantic seaboard. Delivered prices in New England average 0.225c. per pound above those quoted.

Quotations for copper are for the ordinary forms of wirebars and ingot bars. For ingots an extra 0.05c. per pound is charged; for slabs, 0.075c.; and for cakes, 0.125c. up, depending on weight. Cathodes are sold at a discount of 0.125c. per pound.

Quotations for zinc are for ordinary Prime Western brands. Zinc in New York is now quoted at 0.35c. per pound above St. Louis, this being the freight differential. Contract prices for High-Grade zinc delivered in the East are 1@1.15c., depending upon purity, above St. Louis prices for Prime Western.

Quotations for lead reflect prices obtained for common lead, and do not include grades on which a premium is asked.

London

Nov.	Copper		Electrolytic	Tin		Lead		Zinc	
	Standard								
	Spot	3M		Spot	3M	Spot	3M	Spot	3M
14	68	67⅞	81½	177⅛	180⅞	21 1/16	21 1/16	21¼	21¾
15	68⅞	68 1/16	81½	180½	183⅛	22	21⅞	22	22 7/16
18	69¼	69¼	81½	180¼	183¼	21⅞	21⅞	21 13/16	22¼
19	70	69⅛	81½	179⅜	182	21⅜	21⅜	21 11/16	22⅛
20	69½	69	81½	179⅜	182½	21⅜	21 7/16	20 11/16	21⅛

Prices for lead and zinc are the official closing prices for the morning session of the London Metal Exchange; prices for copper and tin are the official closing buyers' prices. All are in pounds sterling per long ton (2,240 lb.).

Silver, Gold, and Sterling Exchange

Nov.	Sterling Exchange "Checks"	Silver		Gold London	Nov.	Sterling Exchange "Checks"	Silver		Gold London
		New York	London				New York	London	
14	$4.87	49⅜	22 9/16	84s11½d	18	$4.86 15/16	49⅝	22 11/16	84s11½d
15	4.87 3/16	49⅜	22 9/16	84s11½d	19	4.86¾	49⅞	22 13/16	84s10¾d
16	4.87 3/16	49½	22 9/16	.....	20	4.86 15/16	49⅞	22 11/16	84s10d

Average: Silver, 49.604c.; Sterling Exchange, $4.8698

New York quotations are as reported by Handy & Harman and are in cents per troy ounce of silver, 999 fine. London silver quotations are in pence per troy ounce of bar silver, basis 925 fine. Sterling quotations represent the demand market in the forenoon. Cables command five-eighths cent premium.

Buyers Consider Lead Cheap

Lead business was excellent, the total tonnage sold being the largest that has been reported for any week in over two months. Apparently, consumers have come to the conclusion that the recent rapid declines in prices are at an end, and that the next movement is likely to be upward, which conclusion would seem to be warranted by existing conditions. About 45 per cent of the demand has been for prompt or November shipment, with about 30 per cent for December, and 25 per cent of the orders for January shipment. This forward buying of lead is unusual. Some sellers have not yet opened their books beyond December. All classes of consumers have been well represented in the market, though the smaller buyers, who take carloads, have not been so much in evidence as they have in recent weeks. One order called for 1,000 tons.

Prices are unchanged at 6.10c. for chemical lead, St. Louis basis, and 6¼c. for desilverized in New York, which latter quotation is the contract price of the American Smelting & Refining Company. Chemical lead in New York is obtainable for about 6.30c. Corroding grades command the usual premium of $2@$3 per ton.

Statistics indicate that the sales for November shipment are likely to fall somewhat below 60,000 tons, a slight reduction from recent months, but it seems likely that any decline in consumption will be offset by the curtailment already effected in production. Refined stocks in the United States and Mexico declined slightly in October, to 71,379 tons, according to the A.B.M.S..

Zinc Unsettled

The tonnage of zinc sold was small. Prices were unsettled, sales taking place at 6.20c. to 6.25c. per pound, St. Louis basis. Almost half of the tonnage sold during the week was at the inside price. The European zinc cartel was in session on Tuesday, and again today. On reports that there was some disagreement among the membership, the London market for zinc sold off today. World zinc production in October was 135,697 tons, against 133,115 tons in the preceding month. The daily rate in October was 4,377 tons, against 4,437 tons in September.

Tin Hovers Around 40c.

Tin prices are slightly higher than a week ago, and give evidence of stability around the 40c. level. Buying has been better abroad, but no great interest has been shown in the market here, though yesterday a good business was done on the metal exchange. Reports of tin being sent to warehouses that do not report their stocks have been a bearish factor, consumers feeling that so long as ample supplies of tin are available, a price advance is unlikely. Three months' Straits is about ⅝c. higher than spot.

Silver Improves Slightly

During the last week, the tone of the silver market has improved slightly, caused by purchase for China account and resulting in a steady advance in prices to Nov. 20. Occasional orders from India have been received, but at prices slightly under the New York quotation. The closing tendency appears steady.

Mexican Dollars (old Mexican pesos): Nov. 14th and 15th, 36½c.; 16th, 36⅝c.; 18th, 36¾c.; 19th and 20th, 37c.

Foreign Exchange

Closing cable quotations on the principal Continental exchanges on Tuesday, Nov. 19, were as follows: Francs, 3.93 9/16c.; lire, 5.235c.; and marks, 23.905c. Canadian dollars, 1 9/16 per cent discount.

Other Metals

Quotations cover large wholesale lots unless otherwise specified

ALUMINUM—Per lb., 99 per cent plus grades, price of leading interest, 24.30c. Outside market, 99 per cent plus, 24.30c.; 98-99 per cent, 23.90c.

ANTIMONY—Per lb., duty paid, New York: Chinese brands, 8⅝c. per lb. for spot and future shipments. Demand for spot improved and with the situation somewhat firmer in primary centers the price here advanced slightly. Cookson's "C" grade, spot, 14c.

BISMUTH—Per lb., New York, in ton lots, $1.70. Smaller lots, $1.80 and up.

CADMIUM — Per lb., New York: 80@90c. Inside price named on contract business.

IRIDIUM — Per oz., $220@$230 for 98@99 per cent sponge and powder.

NICKEL — Per lb., ingot, 35c.; shot, 36c.; electrolytic, 35c. (99.9 per cent grade) for single lots of spot metal.

PALLADIUM — Per oz., $35@$37. Small lots bring up to $46.

PLATINUM — Official price quoted by the leading interest on small orders for refined metal is $65 per oz. Transactions between dealers and refineries in the outside market are reported at several dollars less.

QUICKSILVER — Per 76-lb. flask, $123@$124. Prices irregular, with tone barely steady. Demand slow. Small lots command the usual premiums.

Prices of Chromium, Cobalt, Germanium Oxide, Lithium, Magnesium, Molybdenum, Osmium, Radium, Rhodium, Ruthenium, Selenium, Tantalum, Tellurium, Thallium, Titanium, Tungsten, Vanadium, and Zirconium are unchanged from the issue of Nov. 9.

Metallic Ores

TUNGSTEN ORE—Per unit of WO_3, N. Y.: Wolframite, $15.25@$15.35 for future shipment. Business continues quiet, but with no selling pressure in evidence prices presented a fairly steady appearance. Bolivian scheelite, $15.25, Dec.-Jan. shipment. Western scheelite, $16.50 for Jan. shipment.

Antimony, Chrome, Iron, Manganese, Tantalum, Titanium, Vanadium, and Zircon ores are unchanged from quotations in the Nov. 9 issue.

Week's Output of Concentrate in Tri-State Down 17 Per Cent

Joplin, Mo., Nov. 16, 1929

Blende		Per Ton
High		$45.90
Premium blende, basis 60%		40.00
Prime Western, basis 60%	$39.00@	40.00
Table concentrates, 60%	38.00@	39.00
Flotation concentrate	36.00@	37.00
Average settling price		42.07
Galena		
High		$78.80
Basis 80% lead		75.00
Average settling price, all		76.42

Shipments for the week: Blende, 8,988; lead, 1,652 tons. Value all ores the week, $504,970.

Prices have remained steady, though the demand has dropped to around 6,500 tons for the week.

With the decline in price offerings and lessened demand, several producers closed down their mines at the end of last week. During this week additional mines were closed, decreasing the output for the period some 17 per cent. It is suggested that it will reach 40 per cent next week as well as in the week following.

Restriction will continue to the end of the year, as there are many who cannot afford to continue producing at prevailing prices. With no central directing head, and no organized effort to restrict output, the extent of the curtailment in actual tonnage figures can be told only from week to week as statistics become available.

Platteville, Wis., Nov. 16, 1929

Zinc Blende	Per Ton
Blende, basis 60 per cent zinc	$42.75
Lead Ore	
Lead, basis 80 per cent	$80.00

Shipments for the week: Blende, 608 tons; lead, 40 tons. Shipments for the year: Blende, 29,656; lead, 1,895 tons. Shipments for the week to separating plants, 975 tons blende.

Non-Metallic Minerals

Amblygonite, Asbestos, Barytes, Bauxite, Borax, Celestite, Chalk, China Clay, Diatomite, Emery, Feldspar, Fluorspar, Fuller's Earth, Garnet, Gilsonite, Graphite, Greensand, Gypsum, Iron Oxide, Lepidolite, Limestone, Magnesite, Mica, Monazite, Ocher, Phosphate, Potash, Pumice, Pyrites, Quartz Rock Crystal, Silica, Spodumene, Sulphur, Talc, and Tripoli are unchanged from prices in the Nov. 9 issue.

Metallic Compounds

ARSENIOUS OXIDE (White Arsenic)—Per lb., 4c.

SODIUM NITRATE — Per 100 lb., $2.11 for prompt delivery.

Antimony Oxide, Calcium Molybdate, Copper Sulphate, Sodium Sulphate, and Zinc Oxide are unchanged from prices in the Nov. 9 issue.

Alloys

FERROMANGANESE—Per long ton, domestic and foreign, f.o.b. furnace or duty paid, port of entry, $105. Spiegeleisen, 19@21 per cent, $34 f.o.b. furnace on carload business.

FERROTUNGSTEN—Per lb. of W contained, 75@80 per cent W, $1.45@$1.50, f.o.b. works.

Ferrocerium, Ferrochrome, Ferromolybdenum, Ferrophosphorus, Ferrosilicon, Ferrotitanium, Ferrotungsten, Ferrovanadium, Nickel Silver, and Yellow (Muntz) Metal are unchanged from prices in the Nov. 9 issue.

Rolled Metals

Copper, zinc, Monel metal, nickel sheets, and copper wire are unchanged from prices in the Nov. 9 issue. Lead sheets, full rolled, 10¼c.

Refractories

Chrome Brick, Fireclay Brick, Magnesite Brick, Silica Brick and Zirkite are unchanged from quotations in the issue of Nov. 9.

Iron, Steel, and Coke

IRON—Per gross ton, Valley furnaces: Bessemer, $19; basic, $18.50; No. 2 foundry, $18.50.

STEEL — Base prices per gross ton, Pittsburgh, billets and slabs, $35; plates, structural shapes, and soft steel bars, per 100 lb., $1.90@$1.95.

COKE — Per gross ton, Connellsville furnace, $2.65@$2.75. Connellsville foundry, $3.50@$4.85. Byproduct coke, Ohio and Kentucky (Connellsville basis), $6.50; Buffalo and Detroit, $8.50@$9.

Mining Stocks—Week Ended November 16, 1929

Stock	Exch.	High	Low	Last		Last Div.
COPPER						
Anaconda Copper	New York	86½	70	83¾	Oc. 11 No. 18 Q	1.75
Andes Copper	New York	37	30½	36½	Oc. 11 No. 11 Q	0.75
Arizona Com	Boston	1½	1¼	1¼	Jl. 16 Jl. 31 SA	0.25
Calumet & Ariz	New York	93	73½	88	Se. 6 Se. 23 Q	2.50
Calumet & Hecla	New York	33½	26	31	Au. 31 Se. 30 Q	1.00
Cerro de Pasco	New York	71	52½	70	Oc. 10 No. 1 Q	1.50
Con. Coppermines	N. Y. Curb	7	5¾	6¼		
Copper Range	Boston	18½	15	16½	Se. 14 Oc. 15 Q	0.50
East Butte	Boston	2½	1¾	2	No. 20, De. 21	0.25
Granby Con	New York	60¾	46½	51½	Oc. 18 No. 1 Q	2.00
Greene Cananea	New York	117	106	114	Se. 12 Oc. 7 Q	2.00
Howe Sound	New York	42	35	38½	Se. 30 Oc. 15 Q	1.00
Hudson Bay	N. Y. Curb	12	9½	10¼		
Inspiration	New York	31¾	24¾	30	Se. 9 Oc. 7 Q	1.00
Isle Royale	Boston	16	13½	15½	Au. 31., Se. 30	0.50
Kennecott	New York	67½	49¾	64½	Au. 30, Oc. 1 Q	1.25
Magma Copper	New York	53	35	46	Se. 30, Oc. 15 Q	1.25
Mason Valley	N. Y. Curb	2	2	2		
Miami Copper	New York	31½	24¼	31	No. 1, No. 15 Q	1.00
Mohawk	Boston	47	44	46	Oc. 3, De. 2	3.00
Mother Lode	New York	2½	1⅛	1⅛	Je. 13, Je. 29	0.20
Nevada Con	New York	33½	23½	32⅛	Se. 18, Se. 30 Q	0.75
Noranda	N. Y. Curb	38½	29⅛	34½	De. 10, Ja. 2 Q	0.75
Ohio Copper	N. Y. Curb	1½	*87½	1½	Sept., 1926	0.03
New Dominion	Boston	7½	5½	6	Dec., 1918	.00
Phelps Dodge	New York	42	31	40⅞	Se. 4, Oc. 1 Q	.75
Quincy	Boston	21	17	20½	March, 1920	1.00
Roan Antelope	N. Y. Curb	31	22⅛	28		
St. Mary's M. L.	Boston	26½	22	25	Fe. 25, Mr. 12	2.00
Seneca Copper	New York	3½	2	3½		
Shattuck Denn	N. Y. Curb	10¾	7½	8¾		
Sheritt-Gordon	Toronto	4.45	4.00	4.05		
Tenn. C. & C.	New York	13⅜	9½	12	No. 30, De. 16 Q	0.25
United Verde Ex.	N. Y. Curb	13½	11¼	12⅜	Oc. 2, No. 1 Q	1.00
Utah Copper	New York			325	Se. 18, Se. 30 Q	4.00
Waite-Ack.-Mont.	Toronto	3.50	2.75	3.24		
Walker Mining	Salt Lake	4.65	4.10	4.20		
Wenden Copper	N. Y. Curb	*68¾	*56½	*56½		
LEAD, ZINC, SILVER						
Ahumada Lead	New York	1	*75	1		
Amer. Z. L. & S.	New York	11⅛	7	11	May, 1917	1.00
A. Z. L. & S., pfd.	New York	62	49¾	59¾	De. 12, Ja. 1 Q	1.50
Bunker Hill & S.	N. Y. Curb	106	100½	101	Oc. 24, No. 5 X	0.75
Butte Cop. & Zn.	New York	4½	3½	4	De. 10, De. 25	0.50
Butte Cop. Con	Boston Curb			*31½		
Butte & Sup	New York	6	5	6	Je. 14, Je. 29 Q	0.50
Callahan Zn-Ld	New York	1⅜	1¼	1⅜	Dec., 1920	0.50
Chief Consol.	Salt Lake	3.17½	2.05	3.17½	Fe. 1, 1918 K	0.10
Consol. Ld. & Zn. "A"	St. Louis	8	6	8	Se. 20, Oc. 1 Q	0.25
Constitution	Spokane	*40	*40	*40		
Dayrock	Spokane	2.50	2.00	2.00	Je. 20, Je. 30	0.03
Dickens Consol	Spokane	*5⅜	*5½	*5½		
Eagle-Picher	Cincinnati	14¼	12½	13⅜	Se. 30, Oc. 15 Q	0.20
Eagle-Pich., pfd.	Cincinnati			101	Se. 30, Oc. 15 Q	1.50
Erupcion	Boston Curb			*12	Jan. 1, 1928	0.07½
Eureka Bullion	Salt Lake	*70	*63	*64		
Evans-Wallower	N. Y. Curb	10½	5⅜	7⅜		
Evans-Wal., pfd.	N. Y. Curb			10¾	Je. 20, Jl. 1 Q	1.75
Federal M. & S.	New York			200	June, 1927	10.00
Fed. M. & S., pfd.	New York	98½	97½	97½	No. 25, De. 16 Q	1.75
Gladstone	Spokane	*2½	*2	*2		
Golconda	Spokane	*81½	*76	*81	Je. 15, Jl. 1	0.02
Grandview	Spokane	*24½	*22	*22½		
Hecla Mining	N. Y. Curb	13½	11⅞	13	No. 15, De. 15 Q	0.25
Highland-Surprise	Spokane	*10½	*10	*10		
Jack Waite	Spokane	*10½	*9½	*10½		
Kootenay Florence	Spokane	*8½	*8	*8½		
Lucky Jim	Spokane	*8½	*7½	*7½		
Lucky Tiger-C.	Kansas City		†2.25½		No. 9, No. 20 M	0.02½
Mexican Premier	Spokane	1.90	1.80	1.85		
National Lead	New York	140¾	129¼	139	Se. 13, Se. 30 Q	1.25
Natl. Lead, pfd. A	New York	139½	138	138	Nv. 29, De. 14 Q	1.75
Natl. Lead, pfd. B	New York	116¼	116	116	Oc. 18, No. 1 Q	1.50
N. J. Zinc, new	N. Y. Curb	71½	60½	67	No. 20, De. 10 X	0.50
New Quincy	Salt Lake	1.45	1.20	1.42½	Se. 20, Se. 30 Q	0.10
Noble Five	Spokane	*44	*39	*40		
North Lily	Salt Lake	4.80	4.35	4.35	Oc. 16, Oc. 23	0.25
Park Bingham	Salt Lake	*6½	*6	*6½		
Park City Con	Salt Lake			1.22½		
Park Utah	New York	4½	3½	3¾	Dividends suspended	
Pend Oreille	Spokane	2.90	2.25	2.80		
Rico Argentine	Salt Lake	*18	*16½	*16½	No. 30, De. 15 Q	0.03
Ruth-Hope	Spokane	*22½	*20	*20		
St. Joseph Lead	New York	50	38½	49	Se. 10, Se. 20 QX	0.75
Sherman Lead	Spokane	*50½	*44	*44		
Silver King Coa.	Salt Lake	10.50	9.75	10.00	Se. 20, Oc. 1 Q	0.25
Silversmith	Spokane	*7⅛	*6⅜	*7	Oct., 1926	0.02
Sunshine Mining	Spokane	5.92	5.65	5.92	Se. 10, Se. 20 Q	0.05
Tamarack-Custer	Spokane	*47	*45	*45	Sept., 1924	0.25
Tintic Standard	Salt Lake	11.12½	10.62½	10.75	Se. 17, Se. 20 X	0.30
Tonopah Belmont	N. Y. Curb	*37⅞	*37⅛	*37⅛	Oct., 1925	0.05
Treadwell-Yukon	Toronto	7.00	6.50	6.50		
United Zinc Smg, New	N. Y. Curb			7½		
Utah Apex	Boston	3½	2¾	3	Oc. 15, No. 1	0.25
Utah Met. & Tun.	Boston	*75	*50	*60	Dec., 1927	0.30
Whitewater	Spokane	*24	*20	*20		
Yellow Pine	Los Angeles			*8	Dec., 1925	0.04
GOLD						
Alaska Juneau	New York	5⅜	4½	5½		
Barry-Hollinger	Toronto	*20	*17	*17		
Central Manitoba	Toronto	*29	*20	*20		
Creseon Consol	N. Y. Curb	*50	*37½	*43¾	Se. 30, Oc. 10 Q	0.02
Dome Mines	New York	7½	6	7	Se. 30, Oc. 21 Q	0.25
Golden Cycle	Col. Springs	†16.00	†15.50		Au. 31, Se. 10 Q	0.04
Hollinger	Toronto	5.00	4.85	5.00	No. 15, De. 2 FW	0.05
Homestake	New York	71	65	65	No. 20, No. 25 M	0.50
Kirkland Lake	Toronto	*60	*50	*55		
Lake Shore	Toronto	18.50	17.00	18.25	De. 2, De. 16 QX	0.30
McIntyre Porcupine	New York	12¾	12½	12¾	Nv. 1, De. 2 Q	0.25
Portland	Col. Springs	†*8	†*6		April, 1927	0.01
Rand Mines	New York			25	Au. 21, 29 A.s.	1.50
Siscoe	Toronto	*62	*53	*58		
Sylvanite	Toronto	*45	*40	*40		
Teck-Hughes	Toronto	5.35	5.00	5.30	Oc. 18, No. 1	0.15
Tom Reed	Los Angeles	*55	*45	*45	Dec., 1926	0.02
Unity Gold	N. Y. Curb	*50	*37½	*37½		
Vipond Consol	Toronto	*73	*60	*61	April, 1927	0.03
Wright-Hargreaves	Toronto	1.32	1.20	1.24	Oc. 16, No. 1	0.02½
Yukon-Alaska	N. Y. Curb			35¾		
GOLD AND SILVER						
Carnegie Metals	N. Y. Curb	7	5¾	6¾		
Castle-Trethewey	Toronto	*29	*28	*28		
Consol. Cortez	N. Y. Curb			*6½		
Dolores Esperanza	N. Y. Curb	*31¼	*2›	*31¼	July, 1923	0.05
Keeley	Toronto	*37	*35	*37	Mr. 15, 1928	0.04
Mining Corp.	Toronto	3.50	3.00	3.29	De. 4, De. 19	0.12½
Montana-Mines Corp.	Spokane	*40	*33½	*38		
N. V. & Hond. Ros.	N. Y. Curb	10½	10½	10½	Oc. 16, Oc. 26 QX	0.50
Nipissing	N. Y. Curb	2	1⅝	2	Se. 26, Oc. 21 Q	0.07½
Premier Gold	N. Y. Curb	1⅜	1⅜	1⅜	Se. 12, Oc. 3 Q	0.06
Tonopah Exten.	N. Y. Curb			*10	April, 1925	0.05
Tonopah Mining	N. Y. Curb	2⅜	2	2	Se. 30, Oc. 21	0.07½
United Eastern	N. Y. Curb	*25	*12½	*12½		
Yukon Gold	N. Y. Curb	*56½	*56½	*56½	June, 1918	0.02
IRON AND STEEL						
Bethlehem Steel	New York	88⅜	78½	86⅜	Jan. 18, Fe. 15 Q	1.50
Beth. Steel, pfd, 7%	New York	121½	118	118	De. 7, Ja. 2 Q	1.75
Cleveland-Cliffs	Cleveland	97	97	97	Se. 5, Se. 15 Q	1.00
Colo. Fuel & Iron	New York	38	27⅜	31½		
Colo. F. & I., 1st pfd	New York			127	No. 10, No. 1 Q	2.00
Great Northern Iron	New York	24	20	24	Dec. 15 K	2.00
Inland Steel	New York	80	75	78	No. 15, De. 1 Q	0.87½
Republic I. & S.	New York	77⅛	62½	76⅜	No. 12, De. 2 Q	1.00
Republic I. & S. pfd.	New York	106	103¾	104	De. 12, Ja. 2 Q	1.75
Sloss-Sheffield S. & I.	New York	30	21	26	Mr. 11, Mr. 20 Q	1.50
Sloss-Sheff. S.&I., pfd.	New York	62½	62½	62½	Se. 20, Oc. 1 Q	1.50
U. S. Steel	New York	170	150	164½	No. 30, De. 30 QX	2.75
U. S. Steel, pfd.	New York	139¾	137	138½	No. 2, No. 29 Q	1.75
Virginia I. C. & C.	New York	16	15¼	15¾	Jan., 1924	1.50
Virginia I.C.&C., pfd.	New York			40	Jl. 16, 1928 SA	2.50
MISCELLANEOUS						
Aluminum Co. of Am.	N. Y. Curb	235	180	215½		
Alum. Co. of Amer., pf.	N. Y. Curb	104	103	103¾	Mr. 15, Ap. 1 Q	1.50
American Metal	New York	46½	31½	43	No. 20, De. 2 Q	0.75
Amer. Metal, pfd., 6%	New York	111½	106	106	No. 20, De. 2 Q	1.50
Amer. Sm. & Ref.	New York	75¾	62	73¾	Oc. 11, No. 1 Q	1.00
Amer. Sm. & Ref., pfd.	New York	129¾	123½	123½	No. 1, De. 2 Q	1.75
Ang. Ch. Nitrate	N. Y. Curb	22½	18½	19¼		
Asbestos Corp.	Montreal	4	3	3½	Jan., 1926	1.50
Asbestos Corp., pfd.	Montreal	15	15	15	De. 31, Ja. 15 Q	1.75
Consol. M. & S.	Montreal	255	220	255	Je. 29, Jl. 15 SA	X6.25
De Beers Consol	New York			21	Jl. 23, Jl. 26 Q	0.96
Federated Metals	N. Y. Curb	25	20	22½	Oc. 3, Oc. 11 Q	0.25
Freeport Texas	New York	32¾	23¾	32	Oc. 15, No. 1 Q	1.00
Int. Nickel Can.	New York	32½	25	30¾	No. 30, De. 31 Q	0.25
Int. Nickel, pfd.	New York	112	112	112	Se. 28, No. 1 Q	1.75
Mayflower Assoc.	N. Y. Curb	57½	47	50		
Metal & Mining	N. Y. Curb	10	7½	10	Se. 21, Oc. 1	0.30
Newmont	N. Y. Curb	136	89	130	Se. 30, Oc. 15 Q	1.00
Patino M. & E.	New York	29½	25	27½	Au. 31, Se. 28 A.s.	0.97
So. America G. & P.	N. Y. Curb	1⅜	1⅛	1⅜		
Texas Gulf Sulphur	New York	56¾	42¼	54¼	Se. 2, Se. 16 Q	1.00
U. S. Sm. R. & M.	New York	36½	30½	35	Oc. 7, Oc. 15 Q	0.87½
U. S. Sm. R. & M., pfd	New York	50	48	50	Oc. 7, Oc. 15 Q	0.87½
Vanadium Corp.	New York	55	37½	51	Nv. 1, De. 16 QX	1.75

Toronto Standard Stock Exchange, Toronto, courtesy the Arthur E. Moysey Co.; Salt Lake Stock Exchange, courtesy J. A. Hogle & Co. and Logan & Bryan, New York; Standard Stock Exchange, Spokane, courtesy Pohlman Investment Company

*Cents per share. †Bid or asked. Q, Quarterly. A. Annually. SA, Semi-annually. M, Monthly. BM, Bimonthly. FW, Four weeks. K, Irregular. I Initial. R, Respumption. X, Extra. The first date given is that of the closing of the books; the second that of the payment of the dividend. A.s., American shares.

LONDON QUOTATIONS—WEEK ENDED November 5, 1929

	High	Low	Last	Date	Amount
Alaska Mexican ($5)	12/6	12/6	12/6		
Alaska Treadwell ($25)	66/3	66/3	66/3	Nov., 1926	4 p.c.
Aramayo Mines (25 frs.)	50/—	45/—	50/—	Nov., 1929	5 p.c.
Burma Corpn. (10 rupees)	18/1½	16/1½	17/4½	July, 1929	9 annas*
Bwana M'Kubwa (5s)	28/6	25/1½	26/1½		
Camp Bird (2s)	2/—	1/7½	1/9	April, 1928	16¾ p.c.
El Oro (5s)	3/7½	3/1½	3/6	Nov., 1929	20⅝ p.c.*
Frontino & Bolivia (£1)	7/6	6/10½	7/6	Jan., 1929	3¾ p.c.
Mexican Corpn. (£1)	13/6	12/6	13/3	Oct., 1929	10 p.c.
Mexico Mines of El Oro (£1)	3/9	2/—	2/6	Dec., 1926	3¾ p.c.*
Mount Isa (£1)	32/6	22/6	32/6		
N'Changa Copper Mining (£1)	47/3	37/9	41/3		
Oroville Dredging (4s)	1/6	1/5½	1/6	Nov., 1928	31½ p.c.
Rhodesian Congo Border (£1)	175/—	147/6	171/3		
St. John del Rey (£1)	17/—	16/1½	17/—	Dec., 1929	2½ p.c.
San Francisco Mines (10s)	36/—	35/—	35/3	June, 1929	15 p.c.
Santa Gertrudis (£1)	10/9	10/—	10/3	July, 1929	7½ p.c.
Selukwe (2s. 6d.)	5/10½	5/—	5/3	April, 1917	6¼ p.c.
S. Amer. Copper (2s)	2/3	2/—	2/1½	Nov., 1917	75 p.c.
Tanganyika (£1)	53/—	48/1½	48/9	July, 1929	7½ p.c.
Union Miniere du Haut-Katanga (Brussels)	10,325	9,750	10,000	April, 1929	300 fr. (‡)

*Free of British income tax. †Swiss francs and plus 15 p. c. bonus. ‡Belgian francs and free of taxation.